Australia's Top Selling Electronics Magazine

# Electronics Australia

DECEMBER
1984
AUST $2.30
NZ $3.30

## F/A-18: Australia's new tactical fighter




## Stand-alone EPROM copier

## BEACHCOMBER Metal Detector

**Special Subscription Offer:**
**WIN A PCB ETCHING KIT!**

## Realistic CD player review

## Printers: new technology, lower prices

PRICE BREAKTHROUGH!

# Beeple: the $99 pocket pager

## At last there's a pocket radio pager that YOU can afford.

The Beeple. A small, lightweight and reliable unit that costs a tiny fraction of previous models. It's a price breakthrough!

## What's a Beeple?

It's an instantly accessible automatic radio paging system activated by a simple telephone call. Just dial up the special number and a 'beep' sounds on the Beeple.

Inside the Beeple is an incredibly sensitive radio receiver capable of picking up signals in really bad locations, plus the decoding & logic circuitry necessary to analyse which signal is being received.

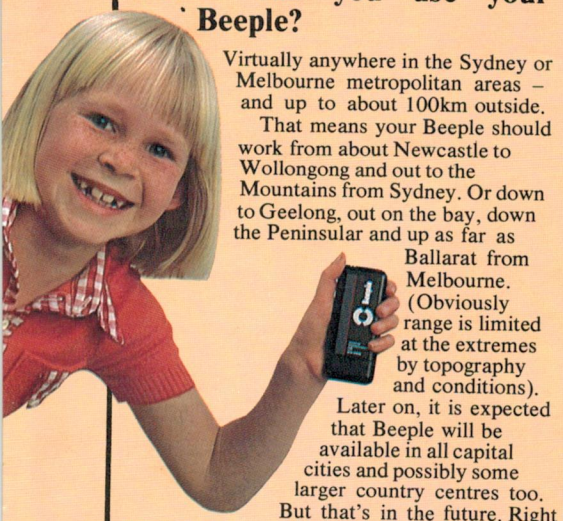
All Beeples share a common radio frequency, which helps keep the cost way, way down. It's up to the Beeple to decide whether the signal is for it: if so, it sounds the beep.

Clever, isn't it!

Because each Beeple can have up to four different access numbers (and four different beeps) you can have a system where you **know** by the sound of the beep who wants you. It's so simple.

Even more, it has a memory facility – in case you're in the middle of an important meeting and don't want to be disturbed. Not even to tell you you've won the lottery and you don't even need to be at work any more!

## Where can you use your Beeple?



Virtually anywhere in the Sydney or Melbourne metropolitan areas – and up to about 100km outside.

That means your Beeple should work from about Newcastle to Wollongong and out to the Mountains from Sydney. Or down to Geelong, out on the bay, down the Peninsular and up as far as Ballarat from Melbourne. (Obviously range is limited at the extremes by topography and conditions).

Later on, it is expected that Beeple will be available in all capital cities and possibly some larger country centres too. But that's in the future. Right now, it's Sydney and Melbourne.

## Who needs a Beeple?

You do!

Businesses have recognised their value for years. Key personnel have been accessible at any time. Even staff 'on the road' have been contactable.

So why should John (or Jill) Citizen own a beeper?

Think of the times you've been away from home and needed to be contacted.

Sometimes trivial, sometimes important – but always impossible to do anything about.

Until now . . . with the Beeple:

Let's imagine Dad's at the station and wants a lift home: and you've gone next door or down to the shops. With the Beeple, you could go anywhere.



Or you go out to a show and spend the whole time wondering if the babysitter has everything under control. Take the Beeple along and you know you can be contacted if something really **is** wrong!

Or the kids arrive home from school and you're still out. They don't know what's happened to you. With the Beeple they can find out where you are.

Or an elderly relative or neighbour is ill: and you can't go out just in case they need help. With the Beeple, you're no more than a phone call away.

Or little Johnny goes out to visit his mates a few streets away. You start to worry when he hasn't come home and ring everyone you can think of. If he had a Beeple in his pocket one call would tell him to come home!

And there are thousands of other uses!

As you can see, it's not just Dad who needs one. Mums and Housewives find them indispensable. The kids can use the Beeple.

**Everyone** can use the Beeple. That's why it's called the Beeple: The Beeper for People!

## Where does it come from?

Beeple is manufactured by the world-famous electronics giant STC, and is serviced by Voicecall, the largest private radio common carrier in Australia.

Because of Dick Smith Electronics wide distribution network, Voicecall suggested that we should include the Beeple in our product range. And seeing the incredible potential of this product breakthrough, we readily agreed!




## How much does a Beeple cost?

Unlike most previous models of pocket radio pager, you buy the Beeple outright for the amazingly low price of just $99

Compare this with many of the 'leased' systems still around now which cost $40, $50 and more **per month!** The Beeple is incredibly inexpensive!

Charges for the Beeple service vary depending on the number of telephone numbers or "tones" you want. The more you get the cheaper each line becomes! Yearly charges are: 1 line $84, 2 lines $104, 3 lines $124 and 4 lines are only $144.

This includes the telephone line rental charge from Telecom, the use of the network of Voicecall radio transmitters to get your paging message out and a service and maintenance agreement which will look after your Beeple for you!

Even in the first year of operation when you have to take into account the yearly charge PLUS the purchase price, you will still be so far ahead of leased pager rates you'll be laughing.

The following year the savings are even greater!

And remember, if you use the Beeple in any type of business, the charge and the purchase price should be tax deductible!

## How do you get a Beeple?



Simple! You go in to your nearest Dick Smith Electronics store in Sydney or Melbourne.

They'll be able to demonstrate the Beeple, show you how to operate it and, best of all, sell you one. Or more!

And they'll also be able (on behalf of Voicecall) to activate your Beeple **on the spot:** you'll walk out of the store with it completely operational! No messy forms to send away and wait weeks for authorisation. It's working from day one!

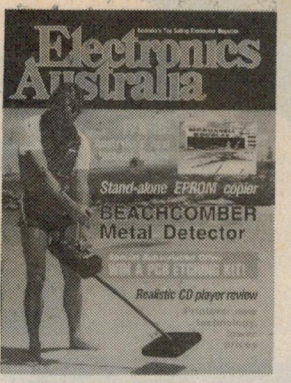
# ONLY $99

DICK SMITH ELECTRONICS PTY LTD

Available in our Sydney and Melbourne area stores only (inc. Newcastle, Gosford, Wollongong and Geelong).

# Electronics Australia

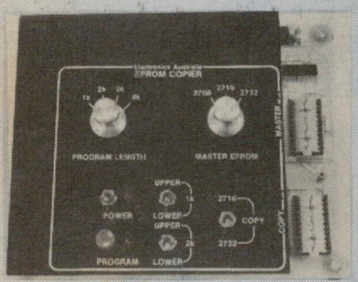
Volume 46, No. 12, December 1984


**On the cover**

*You could strike it rich with the Beachcomber metal detector. It features discriminate, reject and auto-zero circuitry and comes complete with a pre-wound search coil and moulded plastic case. Details page 100.*

## Stand-alone EPROM Copier



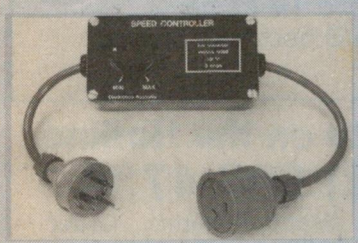

*This EPROM Copier is easy to build and will cost you less than $80. It can program both 2716 and 2732 EPROMs and copy 2708, 2716 and 2732 devices. Construction begins on page 56.*

## What's coming

*Next month, we intend to describe a high-power stereo amplifier and a 30V/1A regulated power supply (see also page 95).*

*Note: due to space restrictions, Op Amps Explained has been held over for this month. The series will resume in January.*

## Speed controller for drills




*Our new Speed Controller is designed for use with electric drills, jig-saws, lawn edge trimmers and other appliances using universal brush-type motors. Details page 42.*

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## Personal Computers


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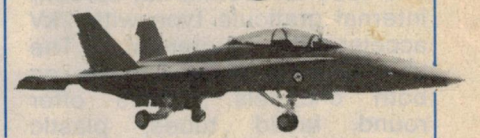

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## Australia's new tactical fighter



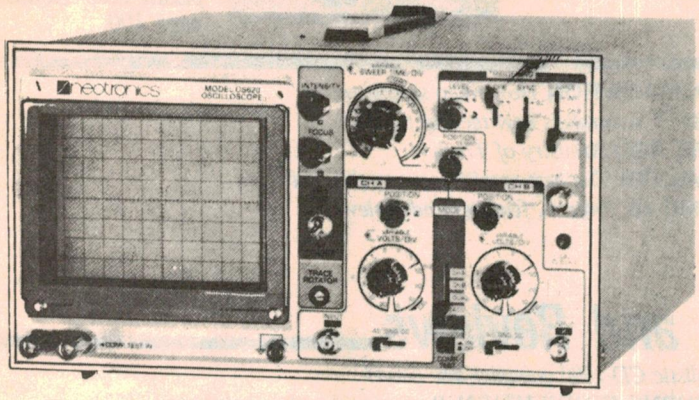
*The F/A-18, Australia's new tactical fighter, is poised at the leading edge of a whole range of aviation technology. We take a look at what Australia is getting for its $4 billion (see page 20).*

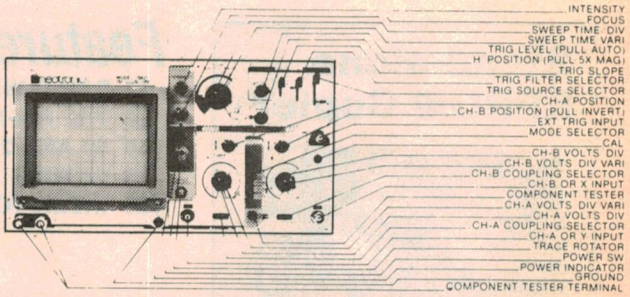
## Printer technology

*New technology, new features and falling prices can make shopping for a printer more confusing than ever before. Turn to page 84 for some straight talking on printer formats.*

IN STOCK NOW

# MORE SCOPE. LESS MONEY.






**$475.00 TAX FREE**

**$551.00 INC. TAX**

**Probes included in price.**



## Price Breakthrough

The Neotronics Model OS620 is a powerful 20MHz dual trace oscilloscope with performance and features normally found on scopes costing $200-$500 more. We sell at lower profit margins and import directly from the manufacturer. You reap the benefit!!

## Built-in component tester

The component tester allows you to make full use of the OS620. With no additional test gear, you can check resistors, capacitors and zener diodes as well as trouble shoot solid state circuits. Testing signals are available via the COMP. TEST terminals.

## Probes included

Most users will need a set of probes. These are sold as very expensive 'extras' with some other brands – often costing over $60.00 a pair (we think this is a bit like selling a car and then saying it's extra for the tyres!). The Neotronics OS620 comes complete with a pair of high quality probes.

## Compare the Features

The Neotronics OS620 is a precision measuring instrument. The tube is 150mm flat screen/ internal graticule type with 2kV acceleration potential. The bandwidth is a full 20MHz on both channels. Others offer round faced tubes, plastic graticules, less bandwidth, yet cost more! Intensity modulation is built in.

## Check these specs

- Vertical sensitivity: 5 mV/div to 20 V/div. 12 ranges
- Operating modes: ch-A, ch-B, dual, add, invert ch-B.
- Rise time: 17nsec
- Time base speed: 0.5μsec to 0.5s/div. 19 Ranges (plus 5X mag.)
- Trigger source: Int, ch-A, ch-B, line, ext and auto.
- Trigger coupling: AC, HF reject, TV line and TV frame.
- X-Y operation: Ch-A becomes Y axis, Ch-B becomes X axis.
- Trace rotation on front panel.

neotronics

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Australia. Telex AA 73264
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Avoid disappointment. Order your OS620 by Bankcard or MasterCard on the phone. Just call up, reverse the charges and we'll take your order. Shipping is only $7.50 anywhere in Australia – including packing and insurance.

**Full 12 month warranty.** Your OS620 is fully guaranteed for a full year.

Prices correct and goods expected in stock at time of going to press.

Electronics Australia

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# Editorial Viewpoint

## Buying software can be a trap

It seems that hardly a day goes by in EA editorial office without the arrival of several press releases for new software packages. These press releases are often couched in the most enthusiastic terms but when read with our usual jaundiced editorial eye (in order to cut out all the bull), they often say very little about the product.

There are several reasons for this. One is that the person who originally wrote the press release knew nothing about the product itself. To some extent this is understandable. After all, learning about a software product is no easy task. It firstly requires an intimate knowledge of the computer it is to be used on and secondly, it requires a good knowledge of the task that the software is supposed to perform.

Often, the companies that market software do not have the resources to employ people with the necessary skills or, if they do, the person concerned is overloaded.

When all this is considered, it is hardly surprising that press releases for new software say little that is worth printing in our magazine.

But that is not the end of the matter. Quite often, there is nothing about the product which is really commendable. In other words, the software will not perform the task for which it was originally intended.

A prime example of this occurred recently. We received a glossy invitation from a large multi-national company to attend the release of a new software package intended for use by magazine artists. It was intended to fully computerise the often tedious and fiddly task of laying out a magazine page. What a good idea. It's been a long time coming.

But when artists from our company attended the demonstration they found the package was unworkable. One of the biggest drawbacks was that it could not be used to lay out a double-page spread! If you have a look through a selection of magazines you will find that most have double-page spreads for articles and often for advertisements too. Yet here was a software package for magazine layout which could not do this major part of the task.

One wonders whether the person who wrote the software in the first place ever talked to the people who would be using it.

Have we come full circle? Many years ago, when mainframe computers were first being introduced to large companies there was a common complaint. The systems analysts did not talk to the people who were presently doing the task that the computer was intended to take over. As a result, there was an enormous cost involved in making the computer do the job properly. Now the same thing is happening with software for personal computers but in a different way.

It can all be summed up quite simply. When it comes to buying off-the-shelf software, particularly brand-new packages, "Let the buyer beware". It is unlikely that any software package will suit a business user's needs exactly. Either the software may have to be modified to suit the task or the task modified to suit the software.

The business user should probably take an even more conservative attitude. He or she should only consider purchasing software written in Australia or, if it is imported, only if it has been modified to suit Australian requirements. Any other approach is likely to be very costly in terms of disruption of normal company activity and the necessary modifications to make it all work.

*Leo Simpson*

# GRAND OPENING

## BURANDA - QLD
## 144 LOGAN RD.

## SMOKE DETECTORS

*The consumer flop that should never have flopped!*

One of the greatest consumer flops of the last decade was the ionization-type smoke detector.

Even though it was a brilliant product is reliable, compact, easy installation, fail safe etc., it just did not sell. Apparently human nature being what it is finds safety-oriented products just not worth the investment however modest. We all know, for example, that accidents and fires never happen to **US!!**

We all know also, that smoke is the greatest killer in a fire. Many fires smoulder for hours before catching alight and causing physical damage.

The US market research gurus thought that a cheap, compact smoke detector would be a mass consumer item. But boy, were they wrong! When they sold for **$49.50** no one wanted them. The price fell to a very reasonable **$29.99** and still they stayed on the supplier's shelves. Jaycar was called in.

We have now been instructed to sell them for less than ½ this amount!!

Now no-one, no-one has an excuse. You owe it to yourself, your children and family to afford them this simple, reliable and low cost protection. If you are a Hotel, Motel or Lodge operator don't miss this wonderful opportunity to install smoke detectors at a never-to-be-repeated price.

**Cat LA-5090**

**ONLY $14.98**



## NEW - PROGRAMMABLE MOBILE ROBOT

Low-cost fun learning with this sophisticated robot! Have hours of educational fun programming this fun device to do what you command through the 25-key keyboard on its head!!

**FEATURES:** ★ 4 bit microprocessor controlled ★ 3 speed gears selected by programming thru' micro ★ Can travel in 4 directions plus angles and curves ★ Has lights and audio ★ Complex routines can be easily programmed (up to 48 commands long).
Cat. XR-1024

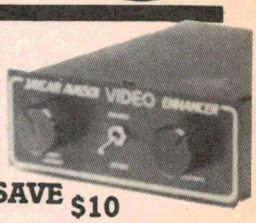
**SAVE WITH JAYCAR - ONLY $49.95**



## JAYCAR VIDEO ENHANCER

A service to the Professional

Designed by a staff member of a well known Australian University and made in Australia. It is the only 625 line 50 frame PAL-D Australian designed and made unit that we know of. The unit features enhance, core/gamma control and by-pass switch. It will drive up to 3 VCR's at once with no degradation and works well as a video distribution amp as well. This is NOT A KIT and is guaranteed for 3 months.
Cat. AV-6501



**SAVE $10**

**NOT $69.95 ONLY $59.95**

**12V AC plugpack** Cat. MP-3020 **$16.95**

## ELECTRONIC BELT DRIVE TURNTABLE - BSR QUALITY

Jaycar has made a sensational SCOOP PURCHASE of B.S.R. belt drive turntables from England at below manufacturers cost!

Two models available AA-0290 works from 9-12V DC and the AA-0292 from 240V AC (includes 12V 400mA adaptor). The DC motor drive is electronically controlled.

**SPECIFICATIONS:** ★ Dimensions 330(W) x 285(D) x 60(H)mm overall ★ Platter diameter 280mm ★ 2 speed - 33 & 45 rpm (internally adjustable) ★ Pick-up arm counterbalanced type with cueing facility ★ Pick-up ceramic (stereo) with diamond stylus ★ Turntable operation - auto stop, will return to rest automatically, turntable chassis is sprung on all corners with transit screws and clips. ★ Weight 1.5kg ★ Output stereo RCA sockets underneath unit.




**SAVE $5.00 PER UNIT**

**CHECK THE PRICE!** Cat. AA-0290
(requires 9-12V DC @ 400mA)

**$24.95** ~~$29.95~~

**240V VERSION** Cat. AA-0292
(includes 12V 400mA adaptor)

~~$39.95~~ **$34.95**

(Post and Packing this item $5 not $4.50)

## IMPORTERS DISTRESS STOCK

This 400 gram spray can is specially formulated for automotive, marine, electrical and electronic applications.

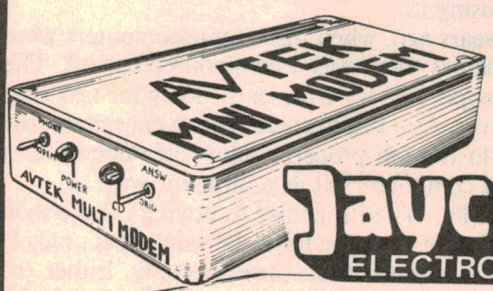
★ Dries out wet ignitions
★ Protects all metals against rust or corrosion
★ Quickly penetrates and frees rusted parts
★ Lubricates close fitting parts
★ Stops battery corrosion and much more.

Cat. NA-1020

**SAVE $3.00**
**ONLY $3.95**




# Fast talkers with all the right answers

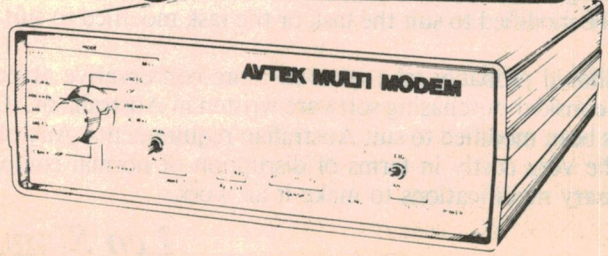



*MultiModem and MiniModem use the latest VLSI technology. Digital signal processing achieves functions normally requiring analogue filters. The result? Reliable data transfer on lines where most modems just won't go!*

## MultiModem only $349 inc. phone

Down the street or across the world, MultiModem speaks the language.

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★ CCITT and Bell standards
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★ Plugs straight in (hardwire phone)
★ Superior VLSI chip performance: works reliably with −43dBM signal with S/N ratio of 6dB.
★ Telecom approval C84/37/1135




## MiniModem only $199 inc. phone

★ 300 baud full duplex
★ Answer/originate
★ Plugs straight in (hardwired phone)
★ Superior VLSI chip performance (identical to MultiModem).
★ Telecom approval C84/37/1173 **Cat. XC-4825**

# "A GREAT XMAS GIFT FOR VIC-20 OR TI-99 COMPUTER USERS"

## BRILLIANT! BOOK/SOFTWARE COMBINATIONS!

Just in hot off the press from the U.S. Publisher! This is the latest way to buy packaged software. You basically get a vinyl case (similar to the case you get when you rent a video tape), a book and a software cassette. The book describes the program and also gives the program listing. The cassette has all of the programs in the book recorded on both sides. On one side of the cassette is a listing of the programs as they appear in the book. Many of the programs COULD contain additional entries to improve operation and provide additional features. If your interest is in programming use this side of the tape. You can then make your own changes and additios to the basic program so that you can see just what happens when the changes are made. Side 2 is an "enhanced" version of the basic program so that you can see just what happens when the changes are made. Side 2 is an "enhanced" version of the programs. This version contains additions to the basic programs to provide more error checking and easier operation for those users whose primary interest is not in programming. The Book/Software combinations represent incredible value-for-money compared to ordinary cassettes! See the specific info on the current titles.

### TI-99/4A COMPUTER
**"51 FUN & EDUCATIONAL PROGRAMS"**

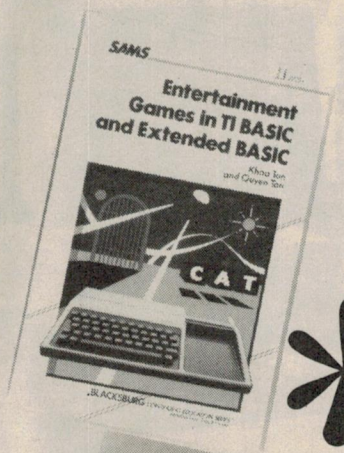
As the title suggests, 51 good examples of TI BASIC in action. They are programs that have practical and useful applications. Programs can be changed to suit specific needs.
The book (94 pages 135(w)x215(h)x8(d)) contains 4 sections as follows: Learning computing by working with numbers and characters - 18 program examples; "Having Fun with Graphics & Sounds" - 10 program examples; "Having Fun with Puzzles & Games" - 11 program examples; "Using Educational Programs for Easier Learning" - 12 program examples.
The cassette has all programs on each side one in standard form the other "enhanced". Both book and cassette come in colourful vinyl case measuring 165(w) x 230(h) x 30(d)mm.

Cat. BS-0750 **$17.95**

### TI-99/4A: 24 BASIC PROGRAMS

24 programs all in TI BASIC. This book/software product runs from child/adult entertainment games to highly applicable household utility and service programs. 6 chapters in all (plus appendix) with many program examples under every chapter heading. Book dimensions 135(w)x215(h)x13(d). 220 plus pages. The cassette supplied has enhanced and standard listings of each program as well. Overall dimensions 165(w)x230(h)x30(d)

Cat. BS-0754 **$19.95**




### TI-99/4A COMPUTER
**"Entertainment Games in TI BASIC & Extended BASIC"**

This book enables the TI computer user to get and play arcade-type games at a very cheap price. With the addition of joysticks and the TI Extended BASIC module you can use this product to its full extent.
Twenty programs in all are included in 21 chapters (one for each program plus a chapter on programming notes). Program titles include: "S.A.M."; "Arrow Zap"; "Cosmic Guns"; "Typing Skill"; "Address Inventory"; "Skeet Shoot"; "Space Battle"; "Killer Crabs Attack"; "Dungeon"; "Black Tunnel" & "Meteor Rescue".
The book measures 135(w)x215(h)x10(d) and has over 170 pages. The accompanying cassette has standard and "enhanced" versions of each program to make loading easy. The entire package is once again enclosed in a colourful vinyl case measuring 165(w)x230(h)x30(d)mm.

Cat. BS-0752 **$19.95**




### VIC-20
**"VIC-20: Games, Graphics & Applications"**

The Commodore VIC-20 has many special features including: ★ User definable character sets ★ Four musical voices ★ A real time clock ★ Colour ★ Graphics.
The book teaches you how to use all of the above features through 20 programs designed for use on the 5K and expanded VIC-20. Whilst the book is great for new VIC-20 users, advanced VIC programmers will find it stimulating as well! Apart from this the book contains joystick games and programs for home applications. Twenty chapters include: "Computer ESP"; "Mind Reading"; "Album Timer"; "Stock Market"; "Floor Planner"; "Motor Race"; "VIC Organ"; "Auto Writer" & "Urban Renewer". Over 130 pages in this 135(w)x215(h)x8(d)mm book. Once again the cassette provides standard and "enhanced" versions of each program. Packaged in a colourful 165x230x30 vinyl case.

Cat. BS-0762 **$19.95**




### VIC-20 COMPUTER
**"VIC-20: 50 Easy-to-Run Computer Games"**

The 135(w)x215(h)x8(d) 122 page plus book describes each of the 50 programs and provides program listing as well. Whilst most of the programs are fairly simple, (no program is over 30 lines) the games cover a wide range of skill and ability levels. This product is ideal for the novice programmer who also likes to play games on his VIC-20.
The cassette supplied has the programs as per the book listing and an "enhanced" version of each program on the other side. Once again the product is packaged in an attractive vinyl case the same size as the other products mentioned here.

Cat. BS-0760 **$18.95**

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**This month's kits from EA**

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# News Highlights



# 2.1GHz distribution system for AAP news service

**Australian Associated Press (AAP), the national independent news agency, has introduced a multi-directional microwave communications system with the launch of an electronic news and information service, The Corporate Report. The Corporate Report provides a comprehensive range of the latest news and data essential for the business community.**

Written in summary form and updated by a specially-assigned team of journalists, the service offers corporate decision makers news and information on a range of topics including financial, industrial, political, and sporting categories, plus financial data on stocks, commodities, money and other markets. A special media topics section provides up-to-date information on editorials in metropolitan newspapers, planned advertising supplements and scheduled current affairs programs on radio and television.

The service uses microwaves for carrying this news and information into the boardrooms and offices of Australian organisations. The concept of microwave transmission of data is the first step in the creation of an AAP communications network that will eventually embrace satellite and terrestrial communications.

Meanwhile, in anticipation of Aussat services towards the end of next year, AAP's multipoint distribution system (MDS) adds a new dimension to conventional data transmission techniques in Australia. Basically, MDS links subscriber video terminals to AAP's database via a metropolitan transmitter (on Centrepoint in Sydney and the Commonwealth Bank in Melbourne) from where the microwave signal is transmitted to a dish in an office or office block.

In tandem with the development of MDS for metropolitan areas, AAP will also cater for the needs of business houses in less populous areas with a sister service, SDS (Small Dish Service). For the SDS the signal will be received via the domestic satellite. Moreover, it will ultimately provide a two-way fully interactive facility that will allow SDS users to interrogate AAP data bases directly via Aussat and also, through an AAP-operated gateway, to databases elsewhere in Australia and overseas.

The multipoint distribution system uses a 2.1GHz 10W signal with capacity for 4Mb/s of encoded digital information (known as RowGrabber) to a reception dish at the subscriber's premises. The signal can be captured virtually anywhere within a 30km radius of the transmission tower.

The reception antennae vary in size, depending on distance from the transmission tower and any signal problems. The smallest is about the size of a coffee mug and can, subject to availability of the signal, be located in the subscriber's office; the largest is about a metre in diameter, which would be used only in difficult locations and would be sited on the rooftop.

Initially, The Corporate Report service will utilize less than ½Mb/s of the 4Mb/s bandwidth. This is adequate to give the required response times and still retain sufficient capacity for expansion of AAP's future services. The central system equipment will continually cycle the pages making up The Corporate Report. The entire report can be transmitted in 10 seconds and its continued cycle ensures that the selected page will be received in five seconds on average.

Subscribers display The Corporate Report using one of two AAP supplied devices, the 4P terminal or the RowGrabber modem (RG modem).

The 4P is a microcomputer based terminal with a 25cm monitor. The base contains the hardware and software necessary to capture the signal and a keypad through which requests are entered.

The 2.1GHz signal will arrive at the microwave receiving antenna, pass through a downconverter and be carried to the 4P via a video cable. Subscribers then view the required page by entering the name via the keyboard and calling it to the monitor screen. If desired, a printer can be attached to the 4P for permanent records of pages.

When the RG modem is used the subscriber's computer equipment will be connected to it using a standard communications interface (RS-232C or V24/V28). The RG modem provides two interface ports, allowing either one or two pieces of subscriber equipment to be connected to it.

The service was launched simultaneously in Sydney and Melbourne on October 12, 1984 by the Minister for Communications Michael Duffy. It will be extended to other cities when the domestic satellite becomes operational.

# Sydney Uni solves VOR problem

**A new antenna which solves longstanding problems in the guidance of aircraft along major aviation routes has been designed by Sydney University's Department of Electrical Engineering and is to be manufactured by an Australian company, Interscan Pty Ltd.**

The antenna dramatically improves the performance of VHF Omni-directional Ranges (VORs), situated on the ground at intervals of about 300km along major air routes throughout the world.

The VORs give out a radio signal which is normally fed into the automatic pilot of an aircraft. However, some VORs are prone to "multipath interference" — when some of the transmitted signal echoes from features in the surrounding landscape — which can cause aircraft on automatic pilot to follow a weaving path, and force the air crew to resume manual control.

The new antenna, designed to fit on top of VORs, improves the quality of the signals they emit. In tests at the University's field station at Fleurs, near Liverpool on the south-western outskirts of Sydney, the new antenna has performed with 10 times the efficiency of conventional antennas, offering a permanent and relatively inexpensive solution to certain multipath problems.

The unique design was developed by the Air Navigation Group in the University's Department of Electrical Engineering led by Dr Godfrey Lucas.

Dr Lucas says the major advantage of the two stack design is that signals are reflected from only a small area underneath the antenna, instead of from a wide area of the surrounding countryside.

The idea arose when the group was approached by the Department of Aviation to investigate the possibility of improving the performance of some VORs by stacking a second antenna on top of the first.

"When we looked at the existing antenna systems, we found that they just weren't good enough to stack", said Dr Lucas. "There was too much mutual coupling between the antennas, so we set about designing an antenna which would minimise this.

"We started with a star-shaped antenna, which went through several modifications until it became a spiral shape."



Photo courtesy Sydney University.

The photograph shows a small section through an antenna, which is a cylinder about 2m long. Two such antennae are stacked one above the other and fed via suitable phasing networks.

Dr Lucas, a Reader in Electrical Engineering, and his co-researchers, Dr Alan Young, now on the staff of the CSIRO, and Mr Paul Hinds, a Senior Technical Officer, received funding for their work from the Department of Aviation.

## Spectrum analysers for Aussat

Aussat Pty Ltd is soon to take delivery of two new Tek 494 Series portable spectrum analysers manufactured by Tektronix Inc.

Tektronix product specialist Mr Ron Milton says Aussat is one of the first groups, internationally, to order the Tek 494, which was only released a few months ago.

The portable 494's allow accurate measurements to be made which can be stored in the instrument's electronic memory, and "dumped" directly into an external computer for analysis or onto a GPIB plotter for permanent recording.

The instrument has a push button "HELP" mode which will guide the novice or veteran user through the fundamentals of spectrum analysis. Information and instructions are displayed in clear English (or one optional language) on the specially enhanced CRT display.

# Suspect chips in high-tech weapons

According to a recent report in *New Scientist*, Texas Instruments in the US is in hot water following its admission that it had inadequately tested millions of silicon chips which found their way into sophisticated military hardware.

Over the years, the chips have been used in a variety of weapons systems, including the B-52 bomber, anti-ship missiles, a range of jet fighters including the F-111 and F-15, and anti-submarine systems. There is no suggestion that the chips used in these weapons are defective — only that they were improperly tested before installation.

Whereas the average chip might, during tests, be exposed to heat for 48 hours, chips to be used in weapons or in space have to undergo up to 240 hours of "burn in" at 125°C. This testing, and its accompanying documentation, is expensive and, for this reason has become prone to abuse.

Earlier this year, National Semiconductor became the first semiconductor manufacturer to be indicted on criminal charges. The company pleaded guilty and was fined $1.75 million for falsifying records. At least four other companies have been in trouble with the Pentagon since 1981 and have, at various times, been removed from what is called the Qualified Products List — the list of companies authorised to supply chips to manufacturers of military equipment.

The US military has good reason to be sensitive about chip quality. In 1980, NORAD computers at Colorado Springs reported a Soviet missile launch against the US. B-52 bombers of the Strategic Air Command were alerted, the false warning later being traced to a single malfunctioning semiconductor device.

# News Highlights

## Arianespace to launch Aussat's third satellite

The Government's satellite company, Aussat Pty Ltd, is to sign a $24 million contract with the European company, Arianespace, to launch Aussat's third domestic satellite. Australian industry and the Overseas Telecommunications Commission will receive orders for work and services valued at about $18 million through offset commitments agreed to by the Government and Arianespace.

Offset work will include the manufacture in Australia of aluminium and steel forgings and castings, valued at between $7.5 and $9 million for the Ariane family of space launch vehicles. This will include, if required, the transfer of appropriate technology to Australian companies to allow the work to meet the stringent quality control required for space vehicles.

Arianespace has also agreed to transfer technology into a wide range of other space industry related activities, plus an order to OTC for tracking and telemetry services, worth $8.5 million.

Aussat has indicated that demand for satellite services is such that the launch of the third satellite, originally intended as a ground based spare until 1988, should be advanced to mid 1986. (The first two satellites will be launched by the space shuttle in late 1985.)

The Arianespace offer allowed launch date options from mid-1986 to mid-1988, giving Aussat considerable flexibility in meeting user demands. The Ariane 3-stage rocket will be used to launch the satellite, at a total cost of $24 million.

## Tight Budget

The forthcoming year in Australian science seems likely to be a bleak one following the recent budget. A meagre 1.6% increase over the 83-84 figure has been allotted to science and technology.

The most likely outcome is a curtailment of industrial research programs throughout the CSIRO, universities and industry. Any government initiatives in high technology will almost certainly be postponed, and a new impetus to the "brain drain" is feared.

## Interference to VCRs

Some VCR models are subject to interfence in the proximity of high power transmitters, a spokesman for the Department of Communications said recently.

Where horizontal coloured bars appear across the screen — even when a commercially recorded tape is in use — the problem may be due to a nearby broadcasting station.

"The problem has arisen largely because of the rapid growth of new suburbs around cities. Originally, radio transmitters were located some distance from residential areas, but with the growth of cities and towns, many householders are now living in close proximity to radio transmitters and find their VCRs are susceptible to interference," said the spokesman.

"Not all VCRs are affected, but our advice to prospective purchasers who live near transmitters is that they should first take the precaution of ensuring their choice of model will be free from interference."

# Motorola AM stereo chosen for Australia

After months of speculation, AM stereo for Australia is to become a reality. The Minister for Communications, Mr Duffy, recently announced that Australia is to have an AM stereo standard based on the Motorola system. The decision to choose a single standard will avoid the type of confusion that severely affected AM stereo's introduction in the US.

For more than a year now, Australia has had experimental AM stereo broadcasts from 14 stations using four different systems: Motorola, Harris, Kahn and Magnavox. This mirrored the situation in the US where a grim battle has been fought for market domination. The Motorola system eventually emerged as the front runner and, in a major blow to its rivals, was recently adopted by several major car companies, including General Motors (Delco), Ford, Chrysler and Nissan.

Understandably, those AM stations in Australia with rival systems are not entirely happy with the Government's decision to adopt the Motorola standard. Nor can it be said that Motorola is technically superior to the three losing systems — all can give good results in most conditions.

The decision to adopt Motorola simply reflects the market reality in the US where, in all probability, the three losing systems will eventually fall by the wayside. In the light of this, it would have been foolish for Australia to have adopted anything but the Motorola system.

Another factor in Motorola's favour was that it is the only system for which an integrated circuit decoder is available. These decoders must be incorporated into AM tuners before they can receive and reproduce stereo sound. The AM stereo transmissions are fully compatible with existing mono radios which will function as before.

Just how good AM stereo will sound will depend on the design of the receivers. With the introduction of stereo transmissions, it is expected that AM receiver design will be substantially upgraded. We could see a range of hifi-standard AM stereo receivers early in the new year.

That being the case, listeners will find that the signal quality of AM transmissions suffers little in comparison with FM sound quality. Both modes have the same potential audio bandwidth of 15kHz (in spite of the nominal AM station spacing of 9kHz), similar levels of distortion and noise, and adequate channel separation.

For in-car entertainment, the AM mode actually has an advantage over FM. AM transmissions are not subject to the multipath distortion effects which can plague FM reception.

Australian radio stations in metropolitan areas are expected to convert to stereo quite rapidly following the Government's decision. Many AM station executives see stereo broadcasts as a way of winning back some of the audience lost to the FM stations. The official launch date has been set for February 1st, 1985 to give stations time to install the necessary equipment.

# at the leading edge

## 3.5″ MICRO FLOPPY STORES 1 MBYTE

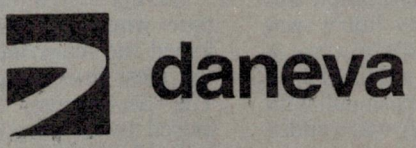
One of Japan's fastest growing floppy disk drive manufacturers, **CHINON,** has released two new double sided 3.5″ microfloppies which accept the **MIC SONY** standard rigid jacket media. The **F-353** is a single sided 80 track drive capable of storing **500KB** and the **F354,** which is a double sided 80 track unit, can hold up to **1 Megabyte.** Both drives measure a mere **104 x 155 x 35 mm** making them one of the most compact data stores on the market.

## MINISCRIBE JOINS THE 3.5″ HARD DISK BRIGADE

Destined to be the standard to displace the medium capacity 5.25″ Winchesters, the 3.5″ units to be released soon from **MINISCRIBE,** will offer considerable scope to designers needing compact data storage to complement the array of portable computers entering the market. While not quite to the level of a solder-in component the 3.5″ drives are prime candidates for hiding away inside equipment to cut panel clutter.

## WHISPERING GALLERY

**VERTEX** increases capacity of their **V170 70MB 5.25″** Winchesters to **85 MB** — details available NOW. **Streaming tape** drive makers to follow the 3.5″ drive outline. New start-up **INTERDYNE** also claims a **floppy look-a-like interface** for their **20MB** offering. **MEGAVAULT** prepares **660MB** 8″ Winchesters, hints at **1.2 Gibabyte** units.




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# Letters to the editor

## A degree is only the beginning

I read with wry amusement your editorial "So you think you're an engineer, mate". It only confirms my view that the training of a good engineer, as with a doctor or lawyer, is barely begun when formal training is completed.

A university degree is only the most basic foundation for a good training in any complex field and at least five years working in the field is necessary to get some degree of competence. In my own experience I've seen many a young "engineer" fresh from his studies come to work in industry, green as grass, and usually sure he knows it all. If he's any good at all after five years he thinks he hasn't really started learning.

From what I've seen you got exactly what's to be expected when you looked for someone very young. They just haven't had time to learn what it's all about!

**I. R. Thomas,**
**Concord West, NSW.**

## From wet electros to computers

I wish to congratulate the editor, Mr Leo Simpson, on his editorial published in the August edition. No matter what the profession or calling of the individual, a thorough knowledge of basic principles is essential. No matter whether the problem be technical, tactical, or lingual, a return to basic principles will usually result in a solution.

I am an old timer. When I first developed an interest in electronics, or radio as it was then called, the standard radio receiver consisted of a 224 followed by a 247 with a 280 rectifier. Filtering was carried out by the field coil of the speaker and a couple of wet upright electrolytics. The term "mellow tone" was applied to the shocking hum level.

As an aspirant for an AOPC licence my dream was to be the proud possessor of a "MOPA" consisting of a couple of 210s. My receiver was an A415 followed by an A409 and had installed what was considered to be one of the scientific marvels of that time (or so I thought): a variable gridleak. It was terribly noisy.

Being employed in the projection side of the cinema industry my hobby was hifi and I had a pair of 245s in class A push-pull. This was later modified to a pair of 2A3's in class AB1 push-pull with fixed bias. The power supply was a choke input filter from an 83 mercury vapour rectifier for good regulation. When fed into a Rola G12 speaker this gave me, what I thought at the time, to be good sound.

Service in signals during the war was followed by five years with the broadcasting branch of the PMG and DCA until I again suffered from "khaki itch" and joined the army once more for another 24 years service until my retirement. During my service I "kept my hand in" by building various pieces of test equipment along with numerous radio and TV receivers, and also carried out quite a bit of part time servicing.

Having now retired, or partly so, I am retracing my steps and taking out my ham licence. That brings me to the point of this letter. Have you given any thought to articles on ham equipment, particularly transmitters and test-equipment? I am an ardent DIY'er from long ago and get the greatest thrill from ironing out the bugs in equipment. I have also developed "computer itch" and have an Acorn BBC model B.

I have the greatest admiration for Mr Neville Williams. No matter what the subject under discussion he always gives the impression of having done his homework completely. His choice of words is well considered and when adversaries try to take him to task he is always able to "shoot them down in flames". Keep up the good work.

Having been a reader since before the time when the late Mr John Moyle joined the magazine I find that one of the most interesting articles is that of The Serviceman. His writings have helped me on many occasions in the past and will continue to do so, I hope, in the future. May he continue with his good work as he also appears to be a most knowledgeable gent.

Wishing you the best for the future.

**J. T. Self,**
**Macleod, Vic.**

## Sleight of hand: Bryan Maher replies

May I thank J. Middlehurst (letters EA Sept 84) for his appreciation of my op amp series. Happily he enjoys an argument: he is about to be embroiled in another.

Input (and output) impedance can only be defined by differentials, ie small changes. The input impedance of anything is measured by applying a small change dV in the applied voltage, and noting the resulting small change dI in the input current (all other conditions being held constant). Then the input impedance $Z_{in}$ is equal to:

$$Z_{in} = \frac{dV}{dI}$$

Fig.9, p98, EA July 84, is the subject of this debate. Here, because there is no feedback to the IC pin 3+ (and we assume that the input conductance and current are both negligibly small), the input impedance looking into the

## Who cares how AM radio works?

Don't you think that it's just a little strange that all the world is out of step except you? Statistically a consistent result is usually a reliable one, so if none (or only very few) of the engineers interviewed could answer your questions then it's just possible that you're asking the wrong questions. You have some quite common misconceptions of what an engineer is and where he fits into the world.

Let's get one thing straight: an engineer's function is to make money with the minimum of time and resources. In your business that requires a broad knowledge of a wide range of matters electronic. (I'm a mechanical engineer with only limited professional experience in electronics but even to one not trained in the subject your approach is shallow.) Yours is a very unusual requirement and I'm not in the least surprised that you're having difficulty filling it.

Out here in the real world engineers are expected to solve problems, not to reinvent wheels, or AM radios, or audio amplifiers, or even nuts and bolts. If problem solving was as simple as that we'd have been computed out of business years ago.

An engineer, when he is required to work on some problem revolving

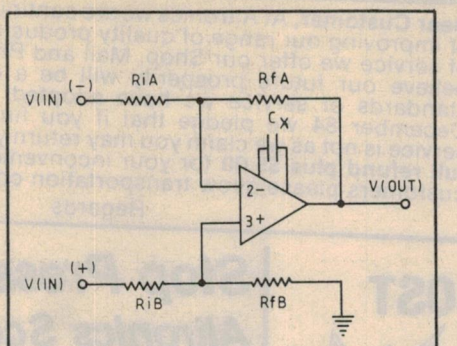
positive input terminal is clearly RiB + RfB.

Now let's look at the negative input terminal with its input voltage V(IN)−. We have stipulated that everything else, including the other input (V(IN)+, be held constant during this measurement. Incidentally we don't care what value V(IN)+ is, as long as it is temporarily held still.

If a small change dV is made in V(IN)−, a small change in current dI will result in RiA. Should that current change attempt to cause any voltage change at IC pin (2−), this would only result in a much larger change of opposite sign in output voltage V(OUT). This, in turn, causes a current in RfA to negate any change in voltage at IC pin (2−).

In other words, we cannot make any appreciable change in voltage at IC pin (2−), despite change in current dI feeding it. We have a virtual earth effect at the IC pin (2−). Therefore it looks as if pin (2−) is grounded as far as the input is concerned.

Therefore the input impedance $\frac{dV}{dI}$ at the negative input is approximately just RiA. So it is true that the input impedances of the two inputs are in fact different.




**Simple differential amplifier circuit. V(OUT) = (Rf/Ri)(VIN(+) − VIN(−)), where R1A = RiB and RfA = RfB.**

$$Z_{in} \text{ at } V(IN-) = RiA$$

$$Z_{in} \text{ at } V(IN+) = RiB + RfB$$

**Bryan Maher,**
**Yeppoon, Qld.**

around say an AM radio, will firstly familiarise himself with the requirements. This is where his training starts to come in.

Next step is always to, if at all possible, buy the required components/equipment/technology from someone who has already "invented that particular wheel". Only very rarely indeed, in the case of well established technologies, is it profitable or necessary to start bogging down into the details. But, if all else fails and detailed design does become necessary, then and only then the engineer will pull out his reference books and get into it.,

So who cares how a superhet AM radio works? You can buy one at Woolworths for less than five bucks. If you need to know how it works your local public library will probably have a satisfactory book on the subject which you can borrow for free.

What questions should you have asked? Well I think for a start that you can take it as read that anyone who has graduated from any of the major universities has an adequate theoretical training. They don't give degrees away. Probably the most important thing for you would be his ability to express himself with clarity and wit. You could number on pterodactyls' teeth the engineers who can do that.

Finally mate, you don't from what I've seen of EA over many years, have either the need of or the work for an engineer. Get yourself a good technically minded journalist and back him up with consultants when he needs them. If you're concerned with the technical side get a good technician. Leave the engineers to find their boredom in some more difficult field.

EA is an excellent magazine in its class, but don't kid yourself that it has anything of substance to offer the professionals.

**J. P. Murphy,**
**Windsor, NSW**

● *The superhet is fundamental to all communications technology and we cannot understand why any self-respecting electronics engineer would have such a total lack of curiosity in the subject.*

*There is no way we could function properly as an electronics magazine without the services and skills of engineers. That is why we have engineers (or people studying the relevant course) on staff.*

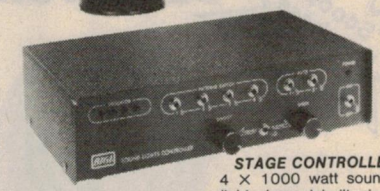
*You say you are a mechanical engineer. Then perhaps you can appreciate that an electronics engineer who does not understand the details of a superhet is like a mechanical engineer who does not understand how a two stroke petrol motor works. Sure you can buy a two stroke motor cheaply, but engineers should still understand them.*


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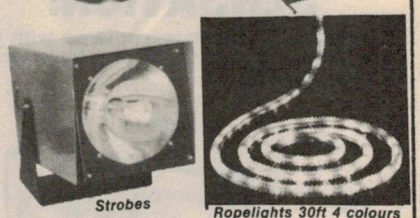



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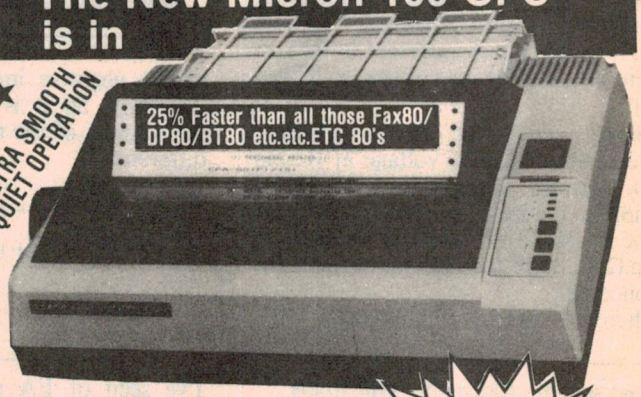
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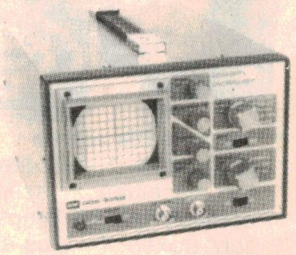
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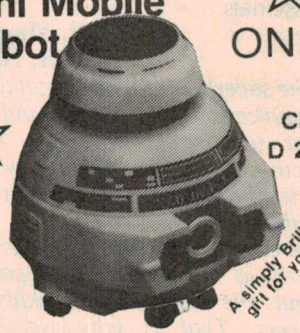
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AS REVIEWED
EA OCT '82 P26-28
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### BSR QUALITY

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**SPECIFICATION**

- ★ Dimensions 330 (W) x 285 (D) x 60 (H) mm overall.
- ★ Platter Diameter 280 mm.
- ★ 2 speed 33 and 45 rpm.
- ★ Pick up Arm Counter balanced type with cueing facility.
- ★ Pick-up ceramic stereo with diamond stylus.
- ★ Turntable operation - auto stop, returns to rest automatically. Turntable chassis is sprung on all corners.
- ★ Output stereo RCA sockets provided.
- ★ Weight 1.5KG.



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CAT.A 0612 **$29.95**

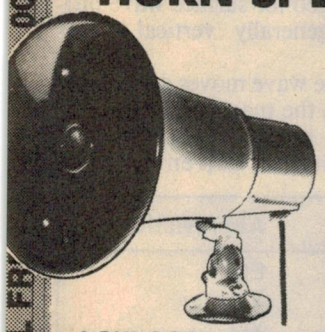
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CAT A 0614 **$39.95**

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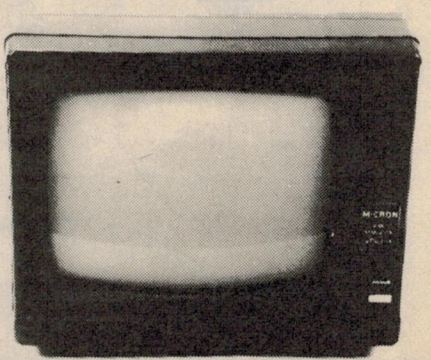
★ 1050 lines resolution at centre screen. ★ 22MHz bandwidth. ★ Video input impedance switch allows networking use. ★ Incredible — repeat Incredible — resolution.

Guaranteed (we mean it) to out perform any other low cost monitor in Australia.

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**SPECIFICATIONS:**
**Screen** — Green phosphor. **Front Controls** — Power on/off, character brightness/intensity, display centering. **Rear Controls** — Background intensity, vertical and horizontal adjustment etc. **Input Impedance** — Switch 75/10K O. **DC Socket** — 12V DC output at 1.1 amp — power your micro direct from the monitor. **Bandwidth** — 10Hz-22MHz. **Resolution** — 1050 lines minimum at centre screen.



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W 0302 per metre ..... .50
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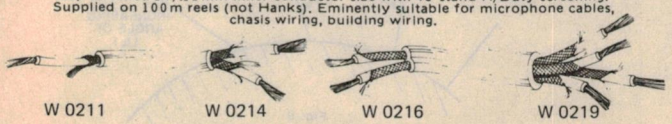
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# Radio wave

*Radio propagation is a complex and little understood subject. This article introduces the topic and discusses the various modes by which radio signals are transmitted.*

There are five basic ways by which a radio wave can travel from a transmitter to a receiver. The five "propagation modes" are space wave, surface wave, sky or ionospheric wave, scatter and satellite transmission. The best mode for a particular task depends on the frequency of the transmission.

## Methods of propagation

When the transmitter and receiver are located in "line of sight", with no obstruction between them, radio waves can propagate in a straight line, although a wave reflected from the ground is also possible (see Fig.1).

The direct line-of-sight wave and the ground reflected wave are known collectively as the "space wave". These are obviously not the only two paths of travel possible however, because otherwise no radio signal would reach a point such as 'R', over the optical horizon of the transmitter. One mode of over-the-horizon propagation is the "surface wave", which travels in close proximity to the Earth's surface and follow the curvature of the Earth (Fig.2).

Radio waves may also reach a receiver by being reflected from the ionosphere, a region of charged particles in the upper atmosphere. The radio wave in this case is referred to as the "sky wave", and follows a path shown in Fig.3.

In addition, radio waves can be transmitted far beyond the optical horizon by "scatter propagation". This is not a reliable method of propagation because of variations in the scattering properties of the atmosphere, but is used when other methods are not available.

Finally, the newest method of radio propagation involves Earth satellites. An artificial satellite placed in orbit at an appropriate height above the Earth picks up the transmitted signal, amplifies it and then retransmits it back to Earth (see Fig.4).

The radio spectrum is divided into various frequency bands, each of which can utilise one or more of the propagation modes mentioned so far. Table 1 lists the various classifications.

## Surface waves

At frequencies below about 500kHz, practical vertical antennas are very small compared to a wavelength. The wavelength of an electromagnetic signal is given by:

$\lambda$ (metres) = 300/f(MHz)

where $\lambda$ is the wavelength in metres. At 500kHz, this works out to be 600 metres.

Practical antennas are smaller than this and, under these conditions, the wave reflected from the ground and the direct wave cancel each other out, leaving only the surface wave. A radio wave consists of an electric field and a magnetic field. The electric field is perpendicular to the surface of the Earth and antennas used for surface wave propagation are generally vertical metal towers.

As the surface wave moves away from the transmitter, the magnetic field is cut by the surface of the Earth, and this leads to induced currents being

| TABLE 1 | Frequency | Classification | Abbreviation |
|---|---|---|---|
| | 30-300Hz | Extremely low | ELF |
| | 300-3000Hz | Voice | VF |
| | 3-30kHz | Very low | VLF |
| | 30-300kHz | Low | LF |
| | 300-3000kHz | Medium | MF |
| | 3-30MHz | High | HF |
| | 30-300MHz | Very high | VHF |
| | 300-3000MHz | Ultra high | UHF |
| | 3-30GHz | Super high | SHF |

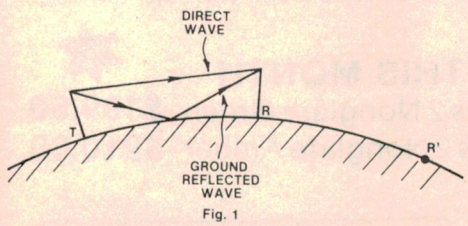


Fig. 1

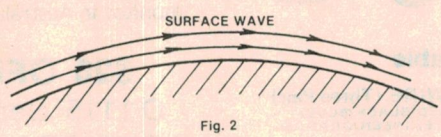


Fig. 2

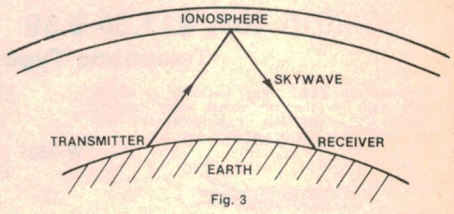


Fig. 3

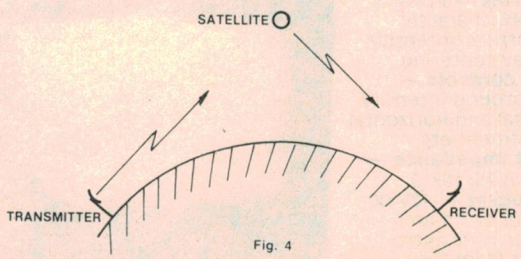


Fig. 4

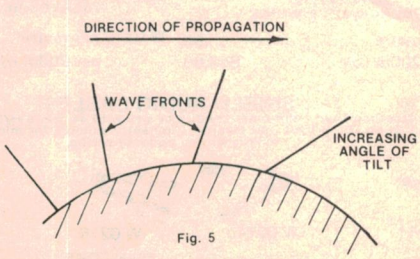


Fig. 5

# propagation

by ELMO JANSZ, VK7CJ

generated in the Earth's surface, which amounts to a power loss. The power is lost to the ground as the surface wave moves forward and the resultant effect is that the surface wave tilts over as it moves forward and could eventually be totally absorbed (see Fig. 5).

The extent to which the surface wave is attenuated depends on the type of surface it passes over. When propagation takes place over sea water, which is a good conductor, and the frequency is below about 100kHz, the surface absorbtion and attenuation due to the atmosphere is very small — and the angle of tilt is the only limiting factor!

The angle of tilt is directly proportional to the frequency. At the low frequency end of the spectrum, waves are able to travel very large distances, even right around the Earth, if the transmission conditions are correct.

Frequencies in this band are thus particularly useful for maritime communications and worldwide time and frequency standards. Ships use about 10 to 100kHz for navigation and communications, and shore-based time and frequency standard stations use fairly high transmitter powers — generally about 1MW — to reach ships at sea.

The Omega navigation system uses VLF radio waves to communicate with submarines at depths of up to 500 metres. (The submarine's towed antenna is at a lesser depth than this, however). Omega stations operate on carrier frequencies between 10 and 14kHz. By measuring the phase differences between signals from several Omega stations, a mobile receiving station can establish its position quite accurately.

Another VLF user is the US Naval Communications station at North-West Cape in Western Australia, which is used to communicate with submarines in the Indian and Pacific oceans.

Similar considerations apply to the medium wavelengths. In this case the physical length of the antenna is made proportional to the wavelength, and practical quarter and half-wavelength antennas are feasible. The amplitude modulated broadcast bands used for domestic radio transmission are in this frequency range.

## Ionospheric propagation

The ionosphere plays a major role in transmissions in the frequency range of 500kHz to 30MHz. The ionosphere is the upper region of the Earth's atmosphere in which gases are ionized by

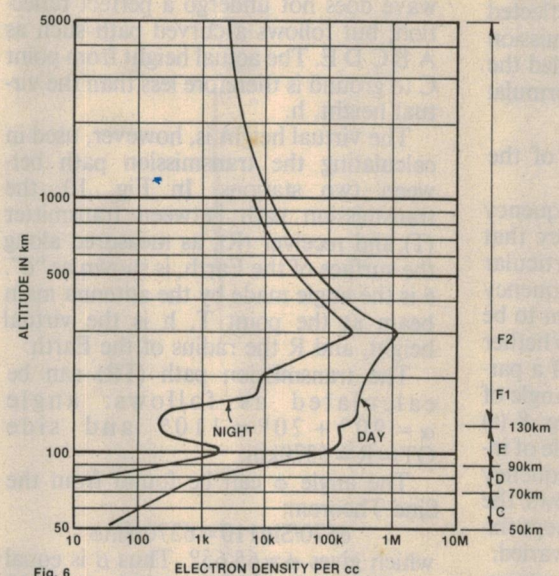



Fig. 6

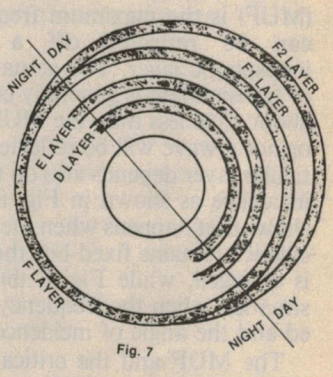



Fig. 7

radiation from outer space, principally solar radiation. The region extends from about 30km to 300km above the surface of the Earth.

The ionosphere itself is divided into several layers in which the maximum intensity of the ionization varies. These layers are designated D, E and F in order of height. During the daytime the F layer splits into two separate layers called F1 and F2. At times a peak electron density has been observed in the D layer, indicating that the region from 50 to 70km above the Earth's surface could be considered as a distinct layer, the "C" region.

Fig. 6 shows a graph of electron density against height above the Earth.

Remember that Fig. 6 shows an average situation. The actual propagation conditions depend on many variables, some of the more common being time of day, seasonal influences, the latitude and the 11-year sun spot cycle. Day to day variations in the ionosphere are referred to as "diurnal variations".

Let us briefly examine the mechanism that gives rive to these layers. At great heights above the Earth, the ionizing radiation is quite intense but the atmosphere is rarefied. Consequently, the few gas molecules present cannot create a significant ionization density.

As the height decreases, the atomospheric pressure and the ionization density increases until a height is reached where ionization is at a maximum. As the height is further decreased, atomospheric pressure increases but the ionization density decreases because the ionizing radiation is absorbed in the process of ionizing the upper atmosphere.

The existence of several layers is explained by the fact that the atmosphere is made up of a mixture of gases, each of which behave in a different manner when exposed to ionizing radiation. Fig. 7 shows the relative positions of the various layers.

The D layer is the lowest of the recognised regions, lying between 70 and 90km above the Earth. The atmosphere in this region is comparatively dense and ions rapidly recombine to form uncharged molecules. Maximum ionization is at noon, diminishing as the sun sets and vanishing completely at night.

The D layer completely absorbs frequencies below 2MHz, so broadcast band transmissions are not reflected during the day. At night the D layer disappears and medium waves are reflected off the next layer above, the E layer. Thus, the range of medium wave stations is considerably increased, allowing interstate broadcast band stations to be heard during the night.

The E-layer lies between 90 and 130km above the Earth. Its ionization increases from sunrise to noon, reaching a maximum at noon. The E-layer also remains weakly ionized at night.

The F-layer is the region of the atmosphere between about 130km and about 500km. At night a single layer oc-

# Radio wave propagation

cupies this region but, during the day, the F layer splits into two layers called the F1 and F2 layers. The F2 layer has the highest level of ionization.

## Maximum Usable Frequency

The highest frequency that is reflected from a given layer when the transmission is perpendicular to the layer is called the critical frequency, given by the formula:

$$f_{crit} = 9\sqrt{N}$$

where N is the electron density of the region under consideration.

The Maximum Usable Frequency (MUF) is the maximum frequency that can be reflected off a particular ionospheric layer. The actual frequency of transmission is generally chosen to be about 15% less than the MUF. Whether or not a wave will be reflected off a particular layer depends also on the angle of incidence as shown in Fig. 8. Fig. 8 (a) shows that happens when the angle of incidence remains fixed but the frequency is changed, while Fig. 8 (b) shows the situation when the frequency is kept fixed and the angle of incidence is varied.

The MUF and the critical frequency are related by the equation:

$$MUF \times \cos i = f_{crit}$$

where i is the angle at which the wave enters the ionized layer.

## Virtual height

Virtual height is the height from which the radio wave would appear to be reflected if it had undergone a perfect reflection — see Fig. 9. However, the wave does not undergo a perfect reflection, but follows a curved path such as A B C D E. The actual height from point C to ground is therefore less than the virtual height, h.

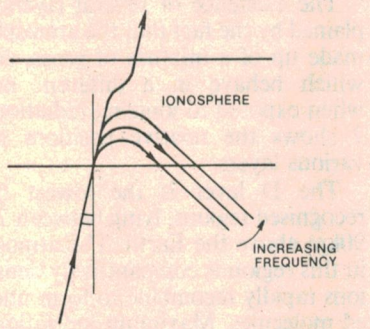
The virtual height is, however, used in calculating the transmission path between two stations. In Fig. 10, the transmission path between transmitter (T) and receiver (R), as measured along the surface of the Earth, is shown as "d". $\theta$ is the angle made by the antenna main beam at the point T, h is the virtual height, and R the radius of the Earth.

The transmission path (TR) can be calculated as follows: angle $\alpha = 90° + 20° = 110°$ and side $OT = R = 6370km$.

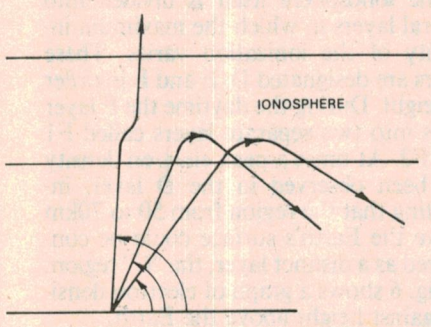
The angle $\phi$ can be found from the Sine Theorem:

$$6570/\sin 110 = 6370/\sin\phi$$

which gives $\phi = 65.65°$. Thus $\beta$ is equal to $180-(110+65.65) = 4.34°$, or .0758 radians. TR can now be found from the equation: Angle in radians = Arc/radius. Thus .0758 = (d/2)/6370, ie. d = 965.9km which is the path TR.




(a)




(b)

Fig. 8

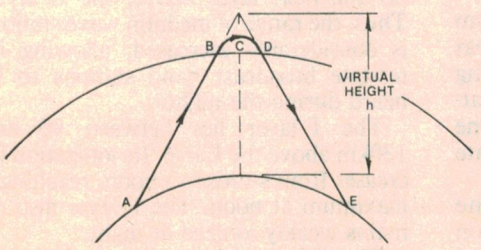



Fig. 9

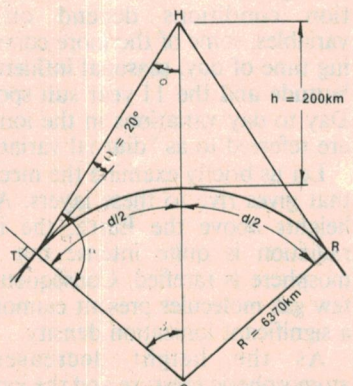



Fig. 10

Measurement of virtual height is usually carried out by an instrument called an ionosonde. A pulse of about 150$\mu$s is transmitted vertically upwards. The reflected wave is received very close to the transmission point and the time t required for the round trip is measured. The virtual height is given by:

$$h = Ct/2$$

where C is the speed of light.

The ionosonde can sweep over a frequency range, for example 1MHz to 20MHz, in about three minutes and has facilities for plotting virtual height against frequency, resulting in a plot which is called an ionogram.

## Skip Distance

There is a minimum distance over which communication at a given frequency can be established by means of the sky wave. Usually the MUF is used for the link. If an attempt is made to shorten this distance by using a smaller angle of incidence, the radio wave will not be returned from the ionosphere, but will pass through it. This minimum distance is called the skip distance — see Fig. 11. For a certain transmission frequency each ionospheric layer has a different skip distance.

For communication between two points separated by more than about 4000km, two or more hops are required as shown in Fig. 12. The number of hops possible depends on the transmitter power and the losses at each ionospheric reflection.

## Ionospheric Disturbances

The ionospheric variations described above are not regular or smooth as assumed, and calculations based on these assumptions yield only approximate results. Some irregularities travel through the ionosphere at speeds greater than 1km/s and are referred to as Travelling Ionospheric Disturbances (TIDs). The causes of these disturbances have not been fully determined, although some contribution is assumed to be made by gravity, electric currents, plasma instabilities and solar activity.

Complete loss of signal has been observed to accompany solar flares. These fade outs occur very suddenly and are known as Sudden Ionospheric Disturbances — (SIDs). They are also referred to as Dellinger fade outs and Mogul-Dellinger fade outs, after Dellinger and Mogul who observed them in the US and Germany respectively.

During solar flares, protons are also emitted by the Sun. These reach the Earth about 30 hours after the flare and affect the Earth's magnetic field, resulting in what is termed a magnetic storm. Magnetic storms affect radio waves, especially at higher latitudes.

Another form of ionospheric irregularity is called Sporadic-E. Thin,

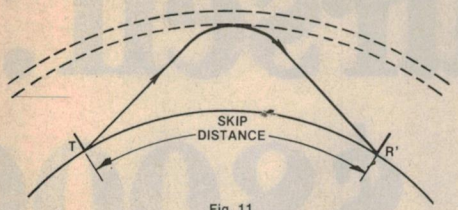
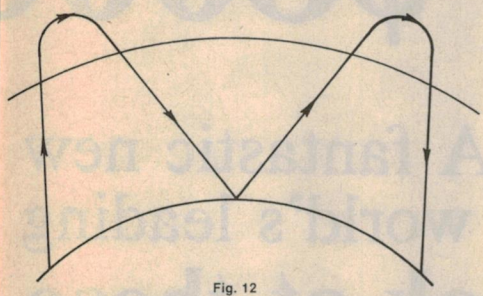


Fig. 11


Fig. 12

highly ionized regions are formed in the E–layer which can reflect very high frequency signals that would normally pass through the ionosphere. These irregularities are formed with no periodicity, hence the name sporadic. Due to these "freak" conditions, distant VHF TV stations can sometimes be received.

Ionospheric or sky wave propagation has been used since the early days of radio, when large distances had to be covered. Recent applications of satellites have overshadowed some of them but, because of its low cost and simplicity, sky wave propagation will continue to be used. Radio amateurs use sky wave propagation to achieve world-wide communication with very modest transmitter powers.

Probably the major application, and the one that will continue for many years, is that of marine communication.

## The Space Wave

Sky wave or ionospheric propagation is not possible at frequencies above about 30MHz, in what are called the VHF and UHF bands. These frequencies pass through the ionosphere. Propagation at VHF and above is restricted to the space wave which travels in the lower region of the atmosphere (called the troposphere).

Slight refraction of radio waves occurs in this region due to the refractive index of the atmosphere, resulting in "radio line of sight" which is somewhat longer than the "optical line of sight".

Space wave propagation is used for FM broadcasting, TV broadcasting, land mobile radiotelephones and point-to-point microwave links. Normally, one or more base stations are used, mounted on a tall building or hill to increase the effective range of the system.

In scatter propagation, frequencies between 350MHz to 10GHz are used. A high power radio wave is transmitted upwards and a very small fraction of the transmitted energy is forward scattered by the troposphere and directed downwards towards the earth.

The forward scattered energy is received by a high gain antenna, normally a parabolic type. The distance between the transmitting and receiving stations is about 300 to 500km and nearly always covers geographically hostile terrain such as mountains, jungle etc. This mode requires high power transmitters and high gain low noise receivers, and is normally used when no others are available.

## Satellites

Communications satellites can be divided into two basic classes called asynchronous and synchronous satellites. The former continuously change their position with respect to the Earth, which leads to antenna tracking problems. The latter type rotates about the Earth's axis at the same speed and direction as the Earth. Under these conditions, the satellite remains in a fixed position relative to the Earth's surface and can thus be used as a repeater station. Three such satellites can be located at an angle of 120° to each other to give complete coverage of the Earth.

The transmitting and receiving equipment on board a satellite repeater is similar to that used on a ground station, except that miniaturisation is used as far as possible and power requirements kept to a minimum. The same antenna is used for transmitting and receiving. Frequencies used are normally 4/6GHz, with transmission and reception on two different frequencies.

At the present time, all overseas TV broadcasts are via satellite and so also are a large number of telephone conversations. The round trip distance for a satellite link is of the order of 70,000km and this leads to a transmission delay in the link. Echo suppressors are used in telephone links to reduce delayed echo to an acceptable level.

Finally, it is worth mentioning the amateur satellites used by radio amateurs. These are popularly called the "Oscar Series" — Orbiting Satellites Carrying Amateur Radio. Unlike the type discussed above these travel across the equator and contact between two stations can be held only for a short time.

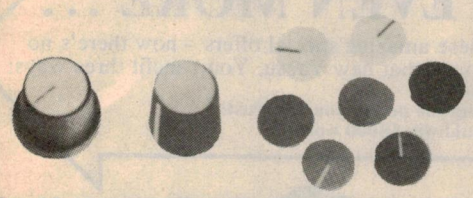
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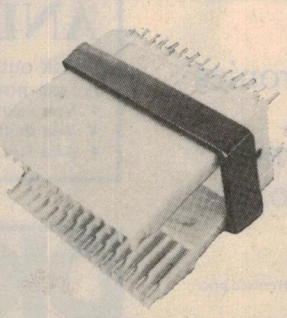
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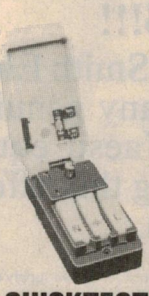
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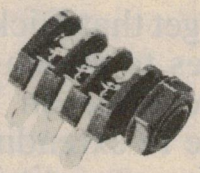
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K10 18.5 x 17mm, K12 19.2 x 25.3mm
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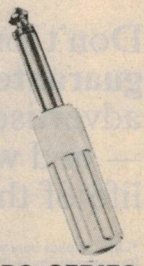
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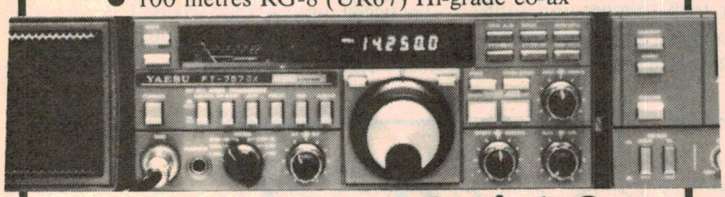
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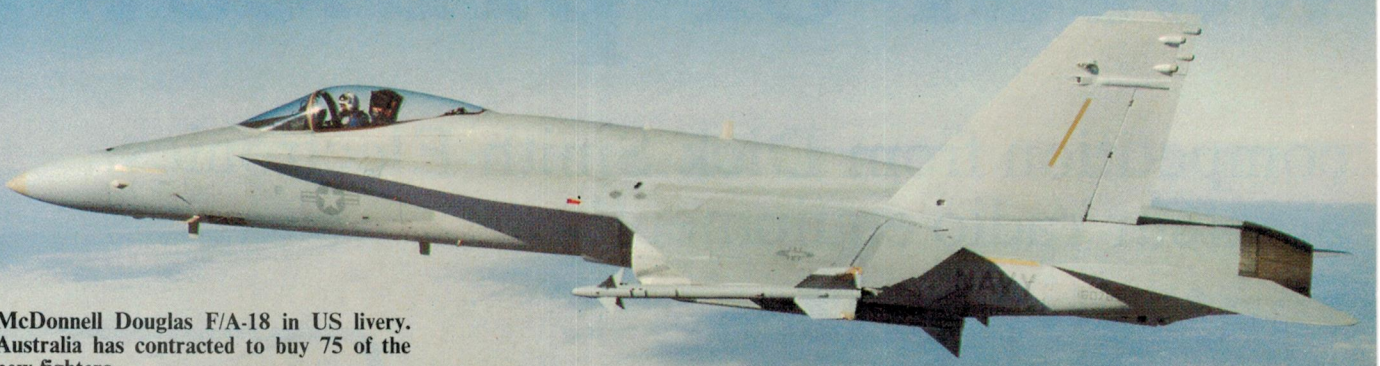
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# The F/A-18:



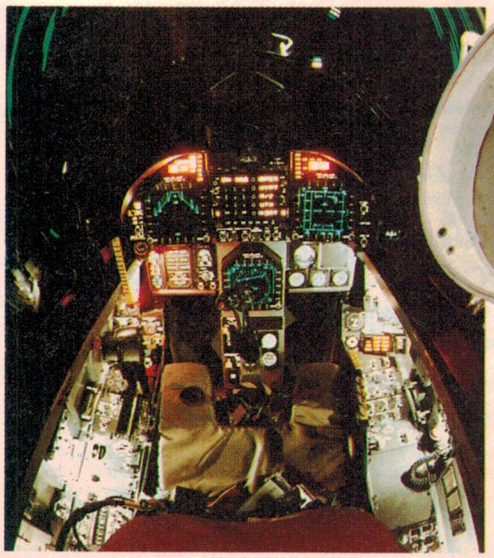
McDonnell Douglas F/A-18 in US livery. Australia has contracted to buy 75 of the new fighters.

## Australia's new tactical fighter

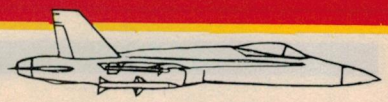
NEVILLE WILLIAMS



Virtually a single, compact package, the Hughes AN/APG-65 multi-role radar system slides out on rails, still operational, to provide for easy access and interchange of modules.



Left: Unlike any other fighter cockpit to date, the F/A-18 cockpit uses electronic display to present to the pilot the information he needs to perform the task on hand. Computerised modules perform supportive tasks automatically, although the pilot can intervene if he so desires.



*One needs to spend only a short time looking over the McDonnell Douglas F/A-18 Hornet, and talking to engineers at the Government Aircraft Factory, to realise that Australia's new tactical fighter is poised at the leading edge of a whole range of aviation technology. But, to readers of this magazine, it will be seen, primarily, as an aircraft packed with state-of-the-art electronics.*

Certainly, the F/A-18 comes as close as any aircraft yet to the computer-controlled, push-button interceptors of science fiction. In fact, US Navy pilots who have been flying it for the past couple of years refer to the plane as the "Tron Machine" — short for electron and reminiscent of the Walt Disney scifi film by the same name.

Pictures and brochures from McDonnell Douglas extol the ultra-modern design of the F/A-18A: its power, speed, range, payload, agility, versatility and ease of maintenance; its "integrated, digital cockpit", with three cathode-ray tubes plus "head-up" facilities for flight data, navigation, radar, weaponry cues, etc; its extensive electronic monitoring and programmable flight control computers, multi-mode radar and radar sensing, weapons guidance systems, inertial navigation, communications, and much more.

Photographs and drawings show how accurately the switchable 7-mode radar with DBS (Doppler beam sharpening) can map a city, an airfield, a river crossing; how it can scan specific sectors ahead of the aircraft, track up to ten potential targets at the one time and provide "illumination" for radar controlled missiles; how the FLIR (forward looking infrared) pod can provide a video picture of buildings, ships or vehicles at night or through heavy overcast.

Typical attack routines are depicted, with the F/A-18 using terrain following for the initial approach, and high-speed evasive manoeuvres over the target, for photographic purposes or in preparation for a further strike.

And, when the plane itself is illuminated by radar, a 360-degree display on one of three CRTs in the cockpit indicates the direction, range and type of signal, allowing the pilot to take appropriate action.

If McDonnell Douglas appear to be unduly forthcoming about the electronic equipment aboard the F/A-18, it is because both they and the US Government want to attract buyers for the plane amongst friendly governments, both to up-date their military resources and to spread the enormous development costs. To win selection — against ten other submissions in the case of Australia — the plane has to be promoted just as deliberately as any other product.

Currently, the US Department of Defence plans to procure 1377 "Hornets" - as they like to call them — with firm orders for 138 more from Canada, 84 from Spain and 75 from Australia, 13 of them double seaters. But, say McDonnell Douglas, "potential allied procurement by nations including Greece, Israel and Turkey could push total program production to more than 2500 aircraft".

Essentially, what the company offers in the F/A-18 is a very sophisticated, very high performance weapons platform which can provide the backbone of an airforce well into the next century. The precise tactical role which the plane might fill, its ultimate instrumentation and weaponry, the manner in which it is maintained and upgraded over the years will all be matters for individual governments.

To a couple of my questions about instrumentation for the RAAF, project engineers at GAF (Government Aircraft Factory) appeared not to know the answer. Their role was to provide the equipment which was regarded as standard to the aircraft. "Classified" equipment would normally be fitted by RAAF mechanics after delivery, they said.

## US, Australian needs

Australia's aquisition of the F/A-18 has been marked by considerable political in-fighting and by controversy within the services, because of its demands on the defence budget — demands which effectively scuttled the Fleet Air Arm. Industry, too, has had its problems, with important phases of the program enmeshed in bureaucratic red tape. But none of that is really surprising in a military re-equipment program that is now likely to leave no change out of $4000 million

Stripped of all that, however, it is simple enough to trace the events that led up to the morning of June 5, last, when a US Air Force C-5A Galaxy transport touched down at Avalon, Victoria, home base of the Government Aircraft Factory. In its hold were two F/A-18s: TF-3 (No. 3 in the Australian order) painted, broken down and ready for reassembly; and TF-4, requiring a much higher content of Australian resources.

It was in 1968 that the RAAF first suggested that planning should begin for an ultimate replacement for their French designed "Mirage" fighter, by then in the latter half of its local production program. At that stage, however, it was decided that, with "life of type extensions", the Mirage could be maintained in service for another 20 years.

That decision was effectively reaffirmed in 1973, when a fighter evaluation team lead by Air Vice-Marshall Robey examined the French Mirage 1, the Swedish SAAB Viggen, the McDonnell Douglas F-15 and the Northrop Cobra, only to reach the conclusion that it would be wise to await one of the new designs which were then in the pipeline.

The matter was raised again in 1976 and, this time, an official request for submissions was released, which yielded eleven responses. Evaluation during the following year reduced the list to five: the Mirage 2000, Tornado, F-16, F-18L and F/A-18. Of these, all but the F-16 and the F/A-18 were eliminated in 1979, with the RAAF opting for the latter in 1981.

Perhaps it wasn't surprising because the F/A-18 was the end result of



# Australia's new fighter



**A typical attack manoeuvre, as depicted in a McDonnell Douglas brochure. The on-board computer system plays an active role in calculating weapon trajectories and providing firing cues.**

American combat experience in Vietnam. Up to that time, both the US Navy and Marine Corps had based their equipment and pilot training on the concept of specialised attack aircraft (eg A7 Corsiar) and specialised fighters (F4 Phantom).

But, faced with the increasing costs and support poblems of single-role aircraft, and with mounting losses due to more effective surface-to-air missiles, the US Department of Defence had to re-think that whole strategy.

Accordingly, it directed the US Navy to initiate a feasibility study directed towards a single, high performance aircraft that would fill both roles, be less vulnerable and, of necessity, easier to maintain under service conditions. The end result was the F/A-18. Developed from Northrop's YF-17, it flew for the first time in November '78 and, after proving and development, entered US squadron service in January '83.

## RAAF requirements

Fortuitously for Australia, the multi-role doctrine, which had to be learned the hard way by the USN and Marines, was one to which the RAAF had long been committed — of necessity but mainly "on paper".

"Of necessity" because the RAAF has long had to make the most of too few aircraft to serve a whole continent.

"On paper" because neither the Mirage nor the Avon Sabre before it have been equal to the task. It took far to long to shuttle Sabres around the Australian continent, while the Mirage never could operate effectively from remote airfields.

Just how the new F/A-18 could change all that was the theme of the maker's 1981 promotional booklet: "The Australian Hornet F/A-18A" — the "A" suffix hopefully anticipating a favourable decision.

## Fighter/interceptor

The aircraft's twin General Electric F404 smokeless engines provide a thrust-to-weight ratio greater than 1.1 (it can accelerate straight up), a maximum speed of Mach 1.8-plus and a combat ceiling above 15,240m (50,000ft). Its efficient aerodynamic design, and powerful leading edge and trailing edge flaps, provide excellent "dogfight" capabilities, with superior turn rate, better climb and better acceleration than existing US fighters.

For close-in encounters, the F/A-18 is normally equipped with AIM-9 Sidewinder IR guided (heat seeking) missiles and a 20mm rapid fire cannon carrying 570 rounds.

Alternatively, with its AN/APG-65 radar and long-range, multi-mode fire control system, the plane can detect and attack threats well beyond visual range, regardless of weather. Up to six AIM-9 Sidewinders or six AIM-7 radar guided Sparrow missiles can be carried, as also the AMRAAM (Advanced Medium Range Air-to-Air Missile).

Again, with external fuel tanks, it can undertake long-range patrol and intercept missions — a vital consideration for the RAAF.

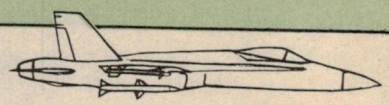
## Attack role

Nine wing and fuselage stations provide a high degree of flexibility for carrying bombs, missiles and fuel tanks, totalling 8165 kg (18,000lbs). This covers all the ordnance and external loads required by the RAAF, including conventional free fall bombs, laser/electro optical weapons and the Harpoon anti-shipping missile, as carried by the P-3 Orion.

(Provision for nuclear weapons has been deliberately omitted from the RAAF version).

**TF-3 outside the McDonnell Douglas factory before disassembly and shipment to Australia.**





For attack missions, the F/A-18 carries the FLIR (mentioned earlier) for day/night surface surveillance, plus a laser spot tracker. Target acquisition is enhanced by the on-board all-weather multi-mode grid mapping radar and inertial navigation system.

## Operating range

The F/A-18 has a normal intercept radius of about 750km (400 nautical miles) or around 1300km with three external tanks. In air-to-ground role, it can attack targets over 1100km away with a substantial weapons load. It can be ferried 3,700km (2000 nautical miles) unrefuelled, e.g. Perth-Sydney, Sydney-Auckland, Darwin-Sydney.

## Remote operations

The normal ARC-182 transceivers, as fitted, provide multiband coverage (UHF/AM, VHF/AM, VHF/FM), all with DF (Direction Finding). Ample provision exists, however, to fit an HF radio system, as well. (HF radio is being installed in the Australian model to ensure continuous communication during long inland hauls, as between Williamtown and Darwin, or during a lonely sea search over the Tasman).

The on-board inertial navigation system is rated for an accuracy of 1.5 nautical miles (2.8km) per hour but it has been consistently bettering this figure in service. If he so desires, the pilot can use the system in conjunction with a projected map as a continuous check on the plane's position.

## Other factors

Over and above its enhanced operating range is the fact that the F/A-18 has two engines and the ability to get back to base if one should fail. This, coupled with indications of inherently greater reliability, gives the RAAF reason to believe that the attrition rate will be considerably lower than for the Mirage, which stands at about one loss per 12,000 flying hours.

Another vital consideration for the RAAF is that the plane, and particularly the undercarriage, has been designed for carrier landings. With substantially the same undercarriage fitted to the Australian version, landings on remote airfields should pose no problem.

According to McDonnell Douglas, a force of F/A-18s can be supported with about one-fifth the spare parts inventory of an equivalent number of Phantoms and Corsairs. And turnaround is faster, because special attention has been paid to ease of access and plug-in modules in the case of most electronic equipment.

As well, the F/A-18s can be completely re-configured at US squadron level from F-18 (fighter) role to A-18 (attack) or vice versa, in less than an hour, providing a unique degree of versatility.

All told, it is little wonder, that the RAAF came down so solidly in favour of the best technology money could buy.

## Industry's role

But, right now, Australian industry has the ball very much in its court, as the first batch or F/A-18s take shape in adjacent hangars at the Government Aircraft Factory. Says McDonnell Douglas:

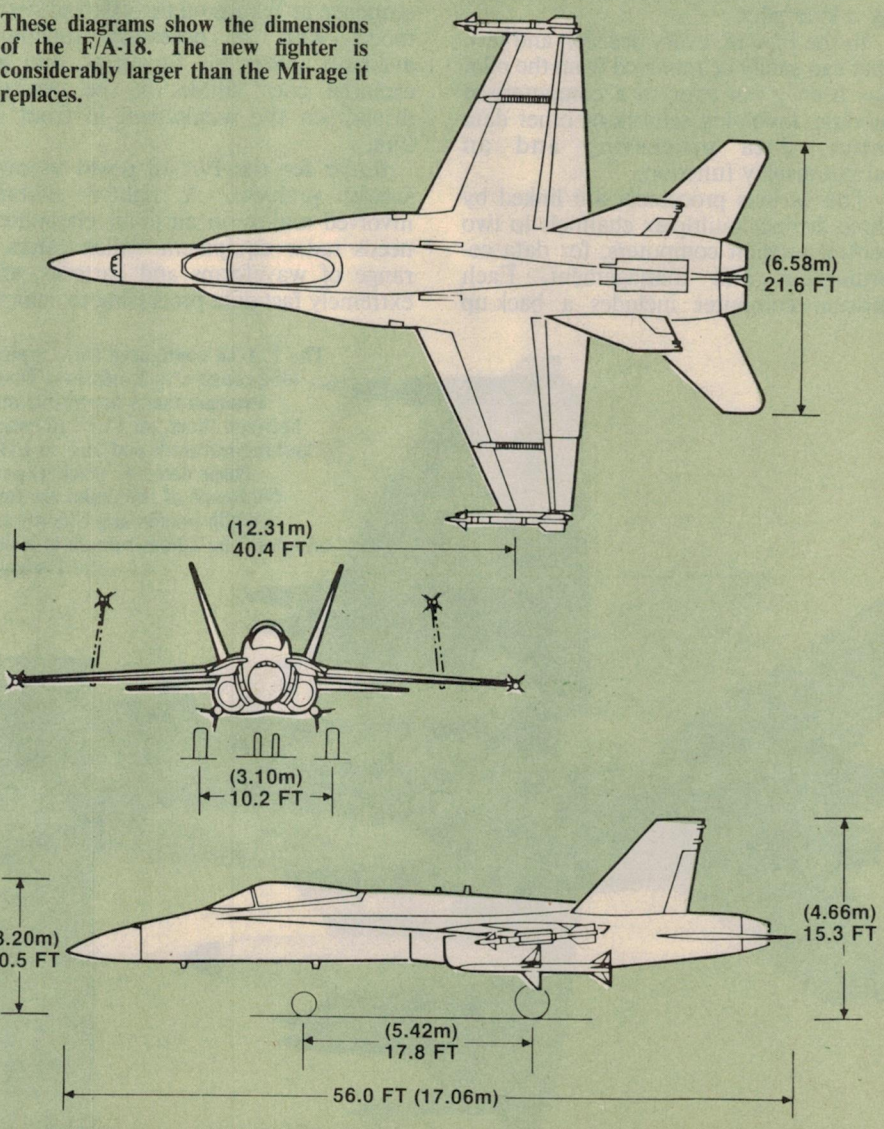
"The F/A-18 introduces titanium hot forming, titanium chemical milling and machining with five axis machines to Australia.

"Adding new plating processes and the manufacture of high strength, low weight, fatigue and corrosion resistant graphite epoxy composite structures, and using hot and cold bonding techniques, will bring Australia completely up to date in the latest airframe construction and repair capabilities.

Major airframe components are also being produced by the Commonwealth Aircraft Corporation at Fishermen's Bend, Vic, and by Hawker de Havilland, Bankstown, NSW.

Other companies involved include Philips Electronic Industries, Sydney (radar system); Lucas Industries,

**These diagrams show the dimensions of the F/A-18. The new fighter is considerably larger than the Mirage it replaces.**



# Australia's new fighter

Zetland, NSW (fuel control and electrical); Dunlop Aviation, Bayswater, Vic (metal fabrication, etc); and British Aerospace Aust, Salisbury, SA (cockpit and head-up display, strain recorder, and AFTA).

## Back to electronics

While the feasibility of the F/A-18 rests heavily on new materials and techniques, on mechanical design and on the compact, powerful engines, it also depends very much on state-of-the-art avionics.

In merging two tactical roles, or two planes into one, McDonnell Douglas have also had to rationalise the responsibilities of three crew members so that they could be assumed, as necessary, by a lone pilot.

In the F/A-18, every decision and task that can safely be removed from the pilot has been given over to a computerised module, involving sensors or other data input, data processing and an output/display function.

The various processors are linked by three distinct multiplex channels to two central mission computers, for data co-ordination and management. Each mission computer includes a back-up facility for the other so that, along with the multiple data paths, the system has a high degree of "survivability".

Included in the system is a built-in test facility (BIT) which can be actuated on the ground or in flight, and which is also programmed to warn the pilot visually of a malfunction, or by a synthetic female voice ("Bitching Betty") in the event of a major emergency.

The basic philosophy of the system, according to McDonnell Douglas, is to allow the pilot to "perform his primary tasks with confidence based on reliable, real-time operation of his computational sub-system".

The same philosophy has governed the design of the cockpit to the point where the pilot can execute a complete attack sequence in "hands on throttle and stick" mode, with all necessary functions available under his fingertips, and all essential cues visible on the head-up display on the windscreen in front of him.

Radar for the F/A-18 posed its own special problem. A fighter aircraft, involved mainly in air-to-air encounter, needs radar equipment which offers a range of waveforms and patterns, and extremely fast data processing to achieve adequate all-altitude target detection. For a ground/sea attack role, however, the emphasis shifts to high resolution, plus copious data storage and management for the returning signals.

To cover both roles with available equipment would have posed a major problem in a tactical fighter but Hughes Aircraft provided an answer with their new AN/APG-65 digitally based system.

A notably compact package, it fits snugly within the nose cone of the F/A-18 and even slides out on rails, still operational, for service. An X-band gridded travelling wave tube allows the pulsed output to be varied on demand, while a software controlled, high-speed processor (7.2 Megabits/sec) provides filtering, storage and processing to match the selected mode and role.

The F/A-18 also makes history as the first-ever fighter to employ digital flight



**US Navy F/A-18s in RAAF markings over the Californian desert. The RAAF will receive its first F/A-18 early in 1985.**



**The F/A-18 configured for a typical long-range attack mission. Three external tanks are visible and between them, an FLIR (forward looking infrared) pod and an LDT (laser detector tracker) pod. Outboard of the tanks are four 1000lb bombs and Sidewinder missiles. The 20mm cannon is inside the fuselage.**



control, described as the "fly by wire" system — "wire" signifying electrical conductors. Commands from the pilot or autopilot are given affect by way of digital signals processed through the computer system.

The computers are programmed to play an active role in flight control, eg by optimising the characteristics of the plane for take-off, landing and normal flight, improving handling and stability, and conveying flight envelope information to the pilot by modifying stick "feel"..

The computers can also be programmed to limit manoeuvres to protect the airframe from destructive forces, and to modify the limit as the fuel and weapons load is reduced. An override switch is to hand, however, for critical "dogfight" situations.

The F/A-18 is fitted with strain gauges at critical points and stresses are recorded automatically, along with a variety of other flight data. As an aid to quick turnaround, fluid levels are also sensed and displayed. Dipsticks are a thing of the past.

To keep a check on all this electronic equipment would be a tortuous procedure, if it were not for the built-in test facility mentioned earlier, which covers 95% of the avionics and a fair proportion of the non-avionics. Mechanics can access the main data bus through a socket in the nose compartment, identify the faulty unit and hopefully replace it with a standby module.

BAe, Adelaide, has now gone one better with a unit which they developed at Salisbury, under contract to McDonnell Douglas: AFTA, short for Avionics Fault Tree Analyser. A rugged portable programmable test computer, it plugs into the data bus socket and having located a fault, proceeds to "question" the suspect section or module, with the object of identifying an individual faulty circuit card.

With AFTA on hand, there is a good chance that modules can be repaired on site, instead of having to be returned to a major repair facility. The reduction in local module inventory and in turnaround delays could be dramatic. Not surprisingly, AFTA is likely to find its way back to the USA and to other countries equipping with the F/A-18.

What kind of men will fly the Tron machine? Well, they will have to be good combat pilots in the traditional sense of the term — products of normal RAAF selection and training and rounded off in a Sperry F/A-18 mini simulator. But they will also need to be comfortable in the world of electronic displays, push buttons, computers, programs and Bitching Bettys — one small step away from scifi.


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## FORUM

Conducted by Neville Williams

**Electronic know-how is in danger of falling to such a low ebb in Australia that we may as well consign the whole lot to Messrs Upcreek & Backwater Ltd. If you haven't heard of the aforesaid company, at least you should recognise their emblem: a Paul Hogan look-alike canoeist in the upper reaches of a lonely creek, surmounted by the slogan "Non paddlei sunt".**

A figment of my own odd-ball imagination, the firm of Upcreek & Backwater Ltd was first mentioned during an "I remember when" address which I gave to the recent Audio Engineering Society Convention in Melbourne. It was a piece of pure whimsy but it was meant to be considered seriously, nevertheless.

Let me clarify the context in which the reference occured:

Retracing more than 40 years in one or other of the editorial chairs of this magazine, I mentioned the so-called "good old days", prior to the mid '70s, when Australia had its own consumer electronics industry, manufacturing both components and built-up equipment.

It hadn't always been that way, with most of the very early "wireless" components being imported from the UK or USA. However, when the industry really got moving in the early '30s, there was a rapid build-up in local production and expertise, with Australian electronics engineers and technicians able to take their place alongside their overseas counterparts.

This on-the-spot expertise greatly simplified the task of producing local technical literature, from product data sheets and manuals through to magazines and textbooks. I speak from experience, because I was involved in them all at various times. For the most part, expert knowledge was no further away than the telephone — or the next meeting of the IREE!

If one needed up-to-date information on valves, there were at least three active manufacturers in the country and at least as many well equipped valve application laboratories — AWV, Philips and Mullard — all of them accessible, capable and ready to help.

Information was readily available, too, on loudspeakers, transformers, inductors, capacitors, resistors, controls, switches and almost anything else you could name. They were either manufactured locally, or imported by somebody who kept in close touch with the suppliers — mostly English-speaking in those days.

Heaven alone knows how many discussions we had with AWA engineers, when the magazine was featuring a series of home-built TV receivers, using AWA deflection components. Similarly, there were countless conferences with Ferguson, A&R, and Red Line about transformers for our valve "Playmaster" amplifiers. We came to know the people concerned as friends.

The same was true of companies involved in manufacturing fully built-up radio and TV receivers, test equipment, amplifiers and electronic musical instruments. Ask a question and, almost routinely, someone would come up with the answer.

### New trade laws

But, in November '73, the Federal Government decided to lower the tariff barriers affecting consumer electronic equipment, ostensibly to improve Australia's trading position. The decision may well have achieved this but, over the next two years, it also caused near collapse of the local electronics industry, with factories closing in rapid succession, and their technical staff dispersed or pensioned off.

Nowadays, a very high proportion of our consumer electronics equipment is imported, with local companies involved mainly in promotion, marketing and after-sales service. For the most part, planning, research, development and production are done overseas, principally in Japan.

And there, of course, is where practical expertise is presently concentrated. Only overseas (mainly Japanese) engineers are able to follow designs from the concept stage to completion; to know the reasons why things were done in certain ways; the factors which governed the choice of individual components and values; the problems which emerged and how they were overcome; areas where compromises had to be accepted — and so on.

Nor is that the end of it. Over and above circuit configuration, equipment such as VCRs, cassette and CD players, involve a whole array of mechanical design problems, plus considerations to do with the software.

To make available and/or acquire that sort of information is difficult and time consuming at the best of times, let alone when those involved have to surmount barriers of time, distance, culture, language, confidentiality and inter-company "politics".

It is a problem that I have become quite accustomed to over the last six or seven years, in my role as an editor and technical writer.

Typically, a Japanese manufacturer will announce the pending release of a new-look whatnot, with features that will put it a jump ahead of all previous and competitive models. In making the announcement, they presumably want to be seen as innovative, at the same time convincing prospective buyers that the new whatnot is worth waiting for.

But, of course, the announcement also creates a demand among magazine readers for information on the new development, and a pressure on editors and technical writers to satisfy it. That's where the going gets tough!

Almost invariably, a request to the local branch of the company for further information elicits no more than confirmation that such a model is in the pipeline, plus a promise to telex Tokyo for more details. Weeks later, further sparse information may turn up, to which can be added snippets picked up or deduced from other sources. It's like assembling a jigsaw puzzle, with half the pieces missing!

Even when the whatnot is actually released, it normally goes first to the domestic market, with the user literature and service manual in Japanese. Only later, perhaps much later, is the design modified to suit other markets and the literature translated into other

# a growing concern

languages. It's a tedious process, which condemns the Australian technical fraternity to a belated and often superficial understanding of the equipment which lines the shelves in our shops and homes.

A prime example of just how confused things can get is provided by Beta and VHS HiFi VCRs, recently released on the local market.

## Beta vs. VHS

It was more than two years ago that Sony first announced the development of Beta HiFi, using technology which, they said, would not be applicable to VHS. But, shortly afterwards, in what appeared to be a carefully measured "leak", Matsushita and JVC let it be known that VHS HiFi prototypes were up and running, and offering the same performance as Beta HiFi. Commercial release was imminent . . . etc.

It transpired that Matsushita and JVC had come up with alternative technology, which they described as "Depth Multiplex" (D-MPX) recording. It involved the use of two extra heads on the video drum and recording the FM audio carriers deeply into the magnetic layer, virtually beneath the video signal on the surface.

That set the stage for a rousing debate on the relative merits of the two approaches but it was one that never really materialised — at least between the principals.

And little wonder because when, some time later, Sony unveiled the PAL version of Beta HiFi, it transpired that they had based it on D-MPX technology, developed for the VHS format! Did they do a last-minute deal with Matsushita/JVC or had they known all along that some such step might be necessary?

With commercial politics running at that level, it was no wonder that the companies were playing the cards close to their corporate chests. Nor was it any wonder that requests for advance technical details were met with courteous evasion!

They were certainly not about to prejudice a major marketing strategy or perhaps a major commercial agreement, just to placate inquisitive journalists from Down Under!

In saying all this, I am not complaining about the quality of imported equipment, or its value for money. I am simply pointing up the fact that, over and above what it costs us in dollars to import our major consumer needs, we are paying a significant further price in terms of technical awareness — and jobs.

It so happened that while I was thinking along these lines, strong criticism was being levelled at the Federal Government for their allegedly inadequate support of local research and development, especially through the CSIRO. In the short term, such economics might seemingly affect very few but, in the ultimate, they could deal yet another body blow to the electonics industry — particularly of the much talked of "sunrise" kind.

Fortunately, the outlook isn't all grim. After spending several days at the Melbourne AES Convention, it became abundantly clear that professional audio is in a world apart from consumer level hifi.

First off, the equipment is not sourced predominantly from any one country, but is produced variously in Australia, New Zealand, Britain, continental Europe, USA, Canada and, of course, Japan. That substantially obviates the language barrier, as far as Australia is concerned, so that access to articles, papers, descriptive literature and specifications is immediate.

***". . . a person who uses equipment in professional situations has to understand it to a far greater degree than is required for ordinary domestic video and hifi gear."***

No less to the point, local manufacturing activities provide a focus for on-the-spot expertise. Local manufacturers must not only know their own product but must also understand and be able to debate what their competitors have to offer. In so doing, they share that understanding with others, whatever product they ultimately select.

That aside, a person who uses equipment in professional situations normally has to understand it to a far greater degree than is required for ordinary domestic video and hifi gear. One gained the impression that the delegates at the AES Convention would be at least as well informed and as capable as their counterparts elsewhere in the world.

Shades of the Australian consumer electronics industry prior to 1973!

The reader may well ask what all that adds up to. Am I saying that we should re-erect the tariff barriers, re-open the old


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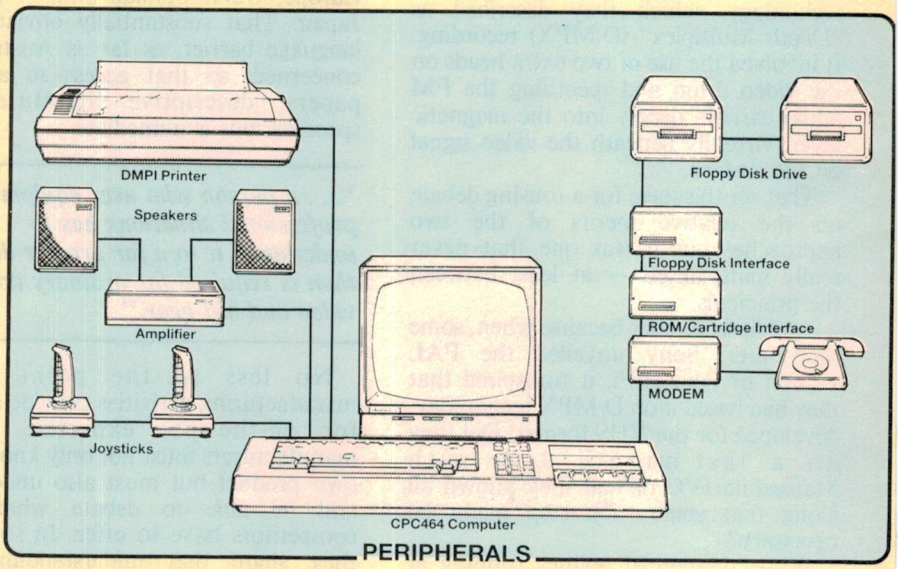
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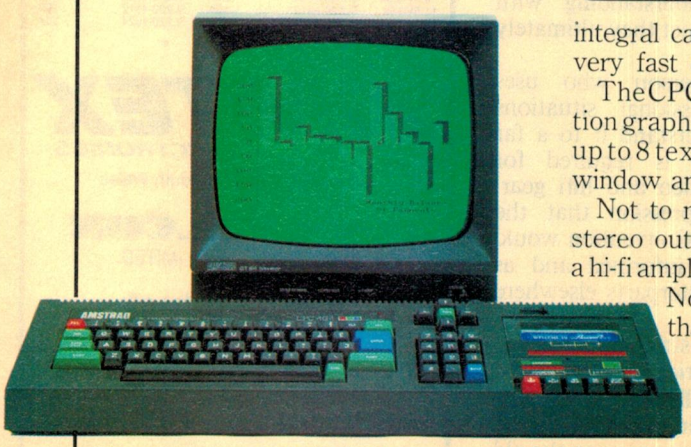
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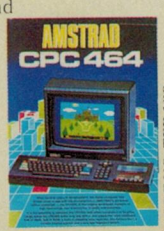
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factories, and revert to components that were, in many cases, less reliable and more expensive than the imported equivalent?

No. The consumer electronics industry in those days was undoubtedly over-protected, inefficient and a candidate for re-structuring. It was "re-structured" all right; it's head was chopped off!

What I am doing here is simply to draw attention to the price we are paying in technical awareness and job opportunities by virtually abandoning consumer electronics manufacture.

Are the decisions of November '73 to remain the pinnacle of wisdom? The last word? Or can we re-balance the equation enough to support at least the nucleus of a local consumer electronics industry?

It's happening with professional audio equipment. How can we extend that effort down-market? That's what I'm on about!

## "Once upon a time" . . .

I continue to receive letters from long-time readers of the magazine expressing their good wishes for my retirement and their thanks for years of interesting reading. It isn't practical to reply individually to every correspondent but it is encouraging to know that efforts put into the magazine personally and by members of the EA team have been appreciated by so many.

A frequent feature of the letters are references to past situations and projects and a few examples have been grouped in this panel by way of interest.

### A shocking suggestion

*I much enjoyed your recent "Forum" on so-called audiophiles.*

*I am a collector of old technical books and I enclose an article from a 1935 Radio Builders Manual. It suggests extending leads from the terminals of a cone speaker or from the primary of the output transformer in "modern" receivers. Connect the leads across a neon bulb so that you can "see" the music, or attach them to a couple of carbon rods and "feel" the music by gripping them in your hands!*

*With modern amplifiers claiming outputs that would shame the Hoover Dam, it might be possible by such means to trigger spontaneous human combustion!*

*Of course, nobody in their right mind would connect themselves to several hundred watts (or the HT circuit, either) but I do wonder whether the abovementioned audiophiles are still in touch with reality.*

**J.R. (Petersham, NSW).**

### Clock watcher!

*I was inspired to start on a pendulum clock by an article in R&H many years ago. I wanted to achieve the best possible accuracy. The design of the Shortt clock was brilliant but I believed that, by the application of a little electronics, I could aspire to this sort of accuracy with only one pendulum. My pendulum rod is invar, with an aluminium temperature compensation tube; it has remained unaltered for 15 years or more.*

*The counting is now by interruption of an infrared beam and the pendulum drive is by gravity arm, released once each minute. The latest variation is to detect the pendulum position for gravity arm release by a second infrared beam, because the constancy of this interference with an otherwise free pendulum is critical to good timekeeping.*

*Current accuracy is 0.5 second per month but I have in mind, one of these days, to see whether it can be improved. Fortunately, barometic variations in Sydney are small enough not to have much effect on timekeeping.*

**A.M. (Nth Turramurra, NSW)**

### Wheat & chaff

*From your earliest articles you showed an ability to sort the wheat from the chaff but, as you have indicated recently, the chaff seems to be taking over again in our industry.*

*I was reminded of one or two early Radio Corporation models. To emphasise the high quality of the sound in one of them, we placed a frequency response "curve" on the rear of the chassis: a straight line from 10Hz to 100kHz, on a vertical scale of ¼in = 10dB. With luck, the speaker might have handled 150Hz to 8kHz!*

*For another new model, cost of new dies was prohibitive, so we changed the shape of the knobs and advertised the model on the basis of "No Squat, No Stoop, No Squint."*

*Maybe "crunge" is in the same class, but I hope it doesn't become part of the language!*

**L.C. (Glen Waverley, Vic)**

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# Steam Sound Simulator FOR MODEL TRAINS

*Build this realistic steam train sound simulator for your model train layout. It features an infrared optical switch to synchronise the "chuffs" to the wheel rotation and, like our Diesel Sound Simulator, picks up its power from the track supply.*

**by ANDREW LEVIDO**

As a follow-on from the Diesel Sound Simulator described in November, we now present a Steam Sound Simulator along similar lines. It is designed to be mounted inside a loco tender or goods van and to pick up its power supply from the track. For this reason it can only be used with pulse power type train controllers such as the *Railmaster* described in September.

As such, it has an advantage over other on-board sound systems in that it does not require a separate battery supply on the train itself.

It is possible to use the track supply to power the electronics because, in pulse power systems, the peak track voltage remains constant over the entire throttle range. Thus we can derive a constant power supply voltage using a relatively simple circuit. The track voltage is obtained from the locomotive and fed to the sound simulator circuit via a pair of fine wire leads.

We originally intended to use a "speed control" system similar to the one used in the Diesel Sound Simulator. That system measured the back-EMF generated by the motor in the locomotive, and used this to control a VCO. This approach worked very well for the Diesel Sound Simulator but a number of problems were encountered in applying it to the Steam Sound Simulator.

When a diesel locomotive comes to a stop the engine will continue to run, even if only at idle speed, so engine sounds will still be present. When a steam locomotive stops however, chuffing ceases. This effect was difficult to implement because different locomotives stopped moving at different throttle settings. It was also difficult to get a realistic chuff rate at all locomotive speeds.

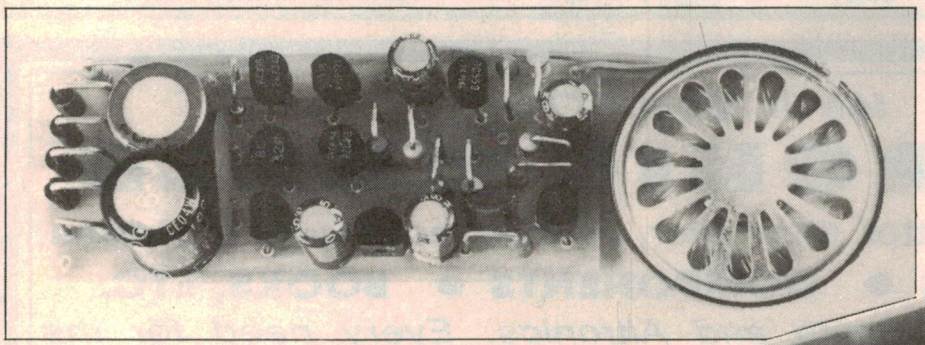
The solution was to use some kind of switch on the wheels, to provide one chuff per wheel rotation. Unlike some units, this circuit avoids the need for fancy mechanics by using an infrared LED and a matching photodiode detector. A cardboard vane attached to the axle of the carriage interrupts the beam of infrared light once every wheel rotation.

Because the steam sound does not have the low frequency content that the diesel sound has, loudspeaker requirements are not quite so critical. We used an insert from a pair of miniature dynamic headphones as the transducer. This fits easily inside the tender or van yet, at the same time, provides reasonable sound output.

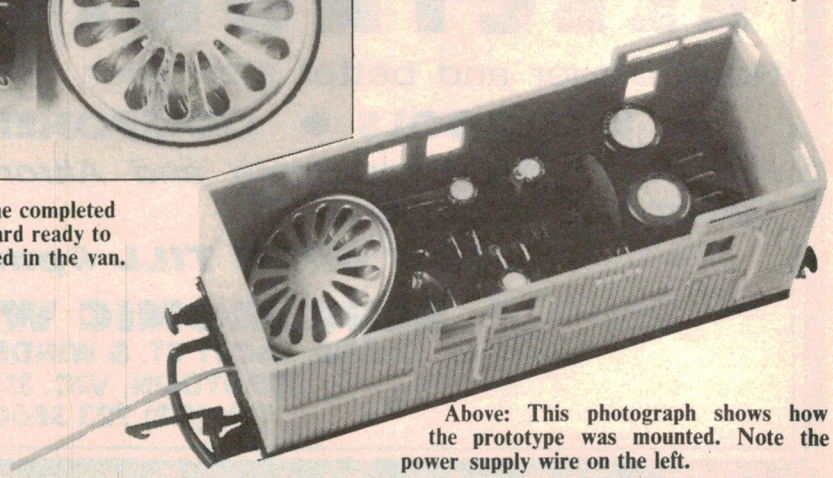
The insert used in the prototype came from a pair of headphones obtained from Dick Smith Electronics for $8.95. Don't throw away the spare transducer; you might wish to make up a second circuit later on. Note that these transducers have an impedance of 32Ω, although you can use an 8Ω speaker if you wish by making one small circuit change (see "how it works").

## How it works

The output of the *Railmaster* train controller consists of a square wave with an amplitude of about 20V and a variable duty cycle. As the throttle is advanced, the duty cycle of the output waveform increases from zero to just



**Above: The completed circuit board ready to be mounted in the van.**

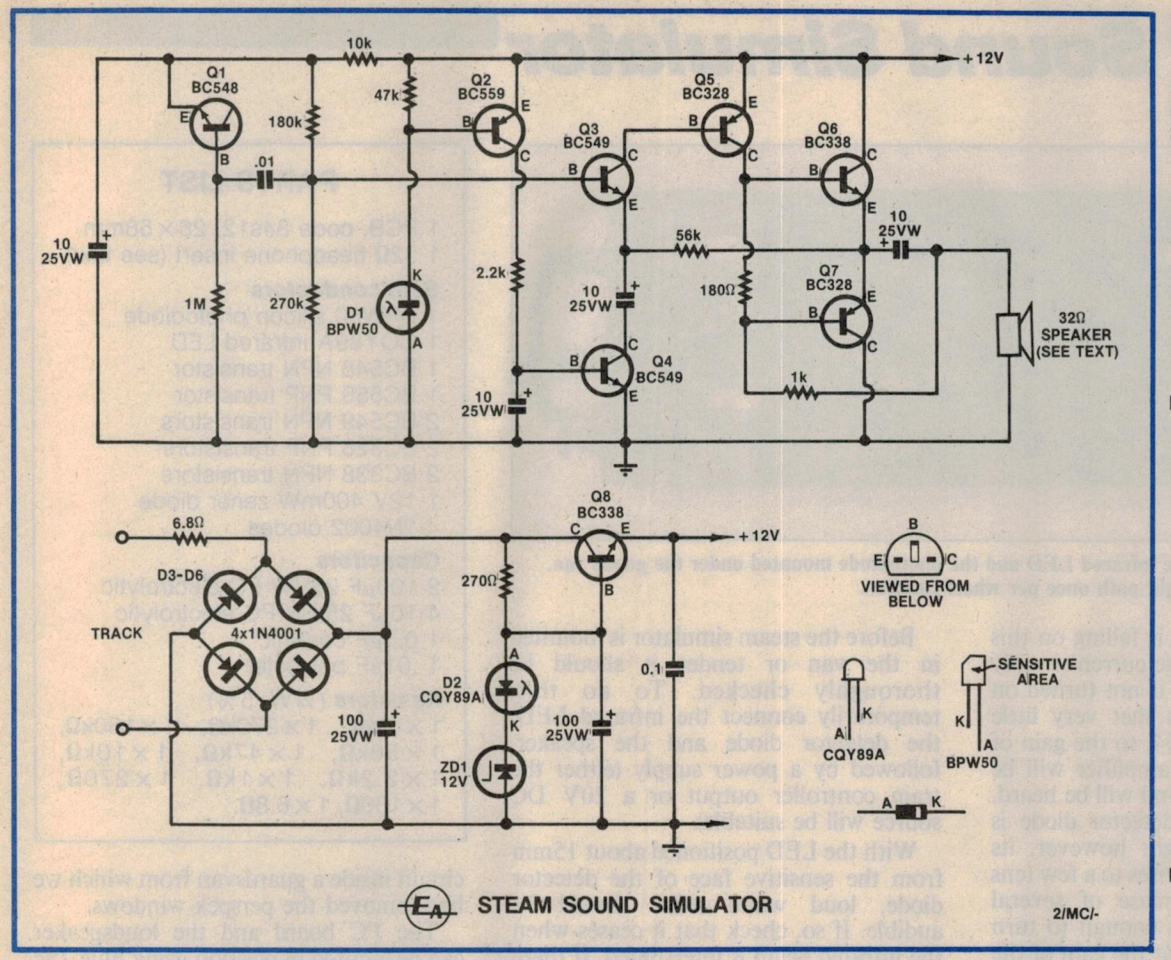


**Above: This photograph shows how the prototype was mounted. Note the power supply wire on the left.**

We estimate the current cost of parts for this project to be

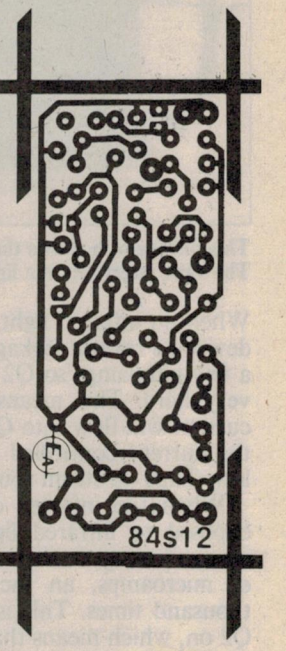
**$14-18**

This includes sales tax but does not include the cost of the miniature headphones.




**Left: The full circuit diagram of the Steam Sound Simulator.**

**Below: Here is the actual size printed circuit board pattern.**




over 50%. The motor responds to the average value of this voltage which thus varies from zero to 12V. The peak voltage, however, remains constant throughout the entire throttle range.

From the circuit diagram, we can see how this characteristic of the controller is exploited to produce a constant supply voltage for the electronics. The 100μF capacitor is charged to the peak track voltage through the bridge rectifier (D3-D6) and the 6.8Ω resistor. The bridge rectifier is used to ensure that the capacitor always charges with the right polarity, even when the train is reversed. The 6.8Ω resistor limits the peak charging current to an acceptable value.

Transistor Q8 and associated components form a simple voltage regulator which provides a stable +12V supply to the electronics. The voltage reference for this regulator is provided by zener diode ZD1 and the infrared LED, D2. These components ensure that a voltage of about 13V is maintained on the base of Q8.

This type of regulator was chosen over a 3-terminal regulator for a number of reasons. Firstly, it has a better start-up characteristic than the intergrated circuit regulators. This means that before the input voltage has risen to a level at which the regulator will begin to operate, it will function as a capacitance multiplier filter. This eliminates the buzzing noise which would occur at this time, if a 3-terminal regulator was used.

This type of circuit also has a lower dropout voltage than a 3-terminal regulator, so it will continue to regulate at a lower input voltage. This again is important when the train is starting or stopping. Another advantage of using this circuit is that we save some current drain by including the LED in the zener diode network, where we would otherwise have to include it in a separate branch.

The characteristic hissing sound of escaping steam is simulated by white noise source Q1. The reverse biased base-emitter junction of this transistor generates about 50mV of noise which is coupled into the base of Q3 via a .01μF capacitor. The 180kΩ and 270kΩ resistors provide bias for Q3, which is the first stage of a simple amplifier. If Q4 is ignored temporarily, it can be seen that this amplifier is similar to the 1 watt audio amplifier published in the November issue.

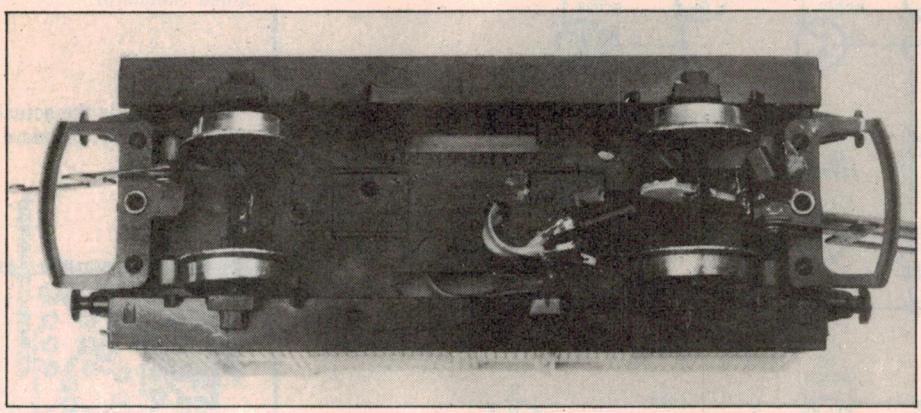
A detailed description of the operation of this amplifier was given in that issue so only a brief rundown of its operation will be given here. Q6 and Q7 form a complementary pair output stage which has the high current gain necessary to drive the low impedance load. The 1kΩ resistor provides output bootstrapping while the 180Ω resistor biases the transistors so as to eliminate crossover distortion. Q3 and Q4 provide the voltage gain of the amplifier and the 56kΩ resistor provides the overall feedback path.

In greater detail, the feedback which sets the gain of the amplifier is provided by the 56kΩ resistor and the network containing the 10μF capacitor and Q4. If Q4 is thought of as a variable resistor, it can be seen that increasing its value will result in an increase in the level of negative feedback applied to the emitter of Q3. This will result in a reduction in voltage gain. In the same way, if the resistance of Q4 decreases the gain will increase.

The actual resistance of Q4, from collector to emitter, depends on the current flowing into its base. Thus the overall gain of this amplifier is controlled by the current applied to this point. This type of circuit is known as a current controlled amplifier. In case you were wondering, the 10μF capacitor is included to prevent any DC flowing through Q4, since this would upset the bias conditions of the amplifier.

The current which flows into the base of Q4 is provided by Q2, which is controlled by the leakage current through the infrared detector diode (D1).

# Steam Sound Simulator



**This photograph shows the infrared LED and the photodiode mounted under the goods van. The vane interrupts the light path once per wheel rotation.**

When no infrared light is falling on this device its reverse leakage current is only a few nanoamps so Q2 is not turned on very hard. This means that very little current will flow into Q4, so the gain of the current controlled amplifier will be low. Thus no steam sound will be heard.

When the infrared detector diode is exposed to infrared light however, its reverse leakage current rises to a few tens of microamps, an increase of several thousand times. This is enough to turn Q2 on, which means that the gain of the current controlled amplifier will be high. Under these conditions the white noise will be audible.

As mentioned earlier, the LED and the infrared detector diode are so arranged that the passage of light between them is interrupted by a vane attached to the axle of the chosen van or tender. In this way the white noise is modulated by the movement of the wheels. (Because the gain of the amplifier is proportional to the amount of infrared light falling on the detector, the attack and decay of each chuff can be varied by the user simply by altering the shape and size of the vane.)

If you wish to use this circuit with an 8Ω loudspeaker it is necessary to re-bias the output stage. This is easily done by replacing the 180Ω resistor between the bases of Q6 and Q7 with a 270Ω resistor.

## Construction

The Steam Sound Simulator is built on a printed circuit board coded 84s12 and measuring 26×56mm. Before mounting any components on the board, it should be thoroughly checked. Make sure that all the holes have been drilled and that none of the tracks are touching. Follow the layout diagram closely when mounting the components. Note that all the resistors are mounted on their ends. This was done to conserve space.

Before the steam simulator is mounted in the van or tender it should be thoroughly checked. To do this, temporarily connect the infrared LED, the detector diode and the speaker, followed by a power supply (either the train controller output or a 20V DC source will be suitable).

With the LED positioned about 15mm from the sensitive face of the detector diode, loud white noise should be audible. If so, check that it ceases when the infrared beam is interrupted. If there is some problem recheck all the wiring and component positioning. Once you have it all working correctly, you are ready to mount the circuit inside the tender or, in the case of a tank loco, in the following guardsvan or a suitable goods wagon.

There must be enough room to mount the PC board and the headphone insert.

Mount the infrared LED and the detector diode in such a way that a vane attached to the axle will interrupt the light path between them. The various components can be held in place using epoxy adhesive and the leads run through small holes drilled in the floor of the tender. Make sure that the vane does not foul anything on the layout (watch the points especially).

In most cases, it will also be necessary to drill holes in the floor of the wagon to let out as much sound as possible. We solved the problem by mounting the circuit inside a guardsvan from which we had removed the perspex windows.

The PC board and the loudspeaker can be secured in position using Blue Tac adhesive. This product is made by Bostik and is available from most hardware stores. Before mounting the board, it will be necessary to make the connections from the LED and photodiode and to connect the power supply leads.

Power for the prototype was obtained directly from the locomotive via a pair of fine wires. A small socket, made from a cut down IC socket, was mounted in the locomotive, and connected to the motor terminals.The stripped and tinned ends of the wires from the sound simulator were then inserted directly into the socket.

The big advantage of this scheme is that it makes it easy to swap locomotives or to disconnect the sound effects tender and transfer it to other layouts.

Finally, if you want to run double-headed trains, just build two sound simulators. The cost is certainly quite reasonable.

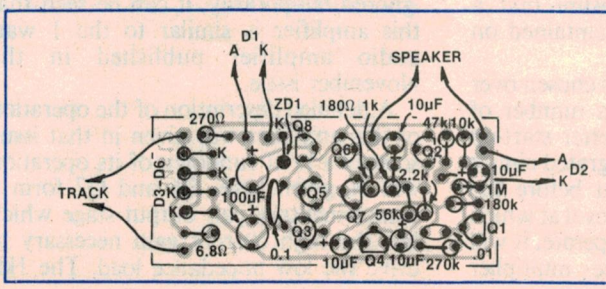
## PARTS LIST

1 PCB, code 84s12, 26×58mm
1 32Ω headphone insert (see text)

***Semiconductors***
1 BPW50 silicon photodiode
1 CQY89A infrared LED
1 BC548 NPN transistor
1 BC559 PNP transistor
2 BC549 NPN transistors
2 BC328 PNP transistors
2 BC338 NPN transistors
1 12V 400mW zener diode
4 1N4002 diodes

***Capacitors***
2 100μF 25VW PC electrolytic
4 10μF 25VW PC electrolytic
1 0.1μF ceramic
1 .01μF polyester

***Resistors*** (¼W, 5%)
1×1MΩ, 1×270kΩ, 1×180kΩ, 1×56kΩ, 1×47kΩ, 1×10kΩ, 1×2.2kΩ, 1×1kΩ, 1×270Ω, 1×180Ω, 1×6.8Ω.

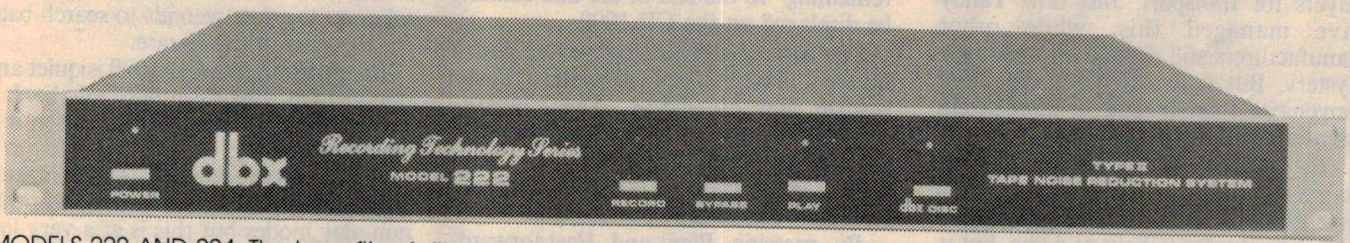



**Here is the circuit board overlay. Watch the orientation of the polarised components.**

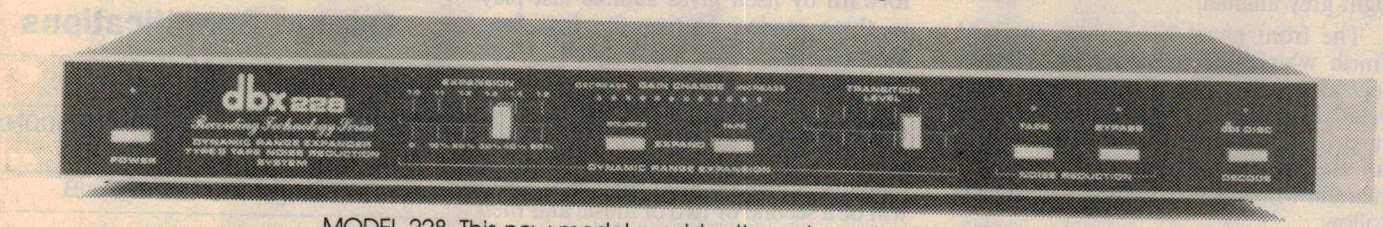
# Here are four good reasons to dbx your sound system

No matter how good your sound system is, you are limited by one major thing: the record. Every normal record is severely limited in musical range. Compression during cutting results in half the dynamic range being eliminated. The excitement of the music is lost. This applies to digitally mastered and direct to disc recordings. The other problem is something you hear every time the stylus enters the groove: surface noise. We went to the source of the problem, the cutting of the record. We encode the record by compressing it 2:1. The decoder expands back in a mirror fashion. In this way, the vinyl record can achieve a staggering 90dB dynamic range, compared to 50dB achieved on normal high quality recordings. Only through dbx can you truly appreciate digital recordings. The range of dbx discs is growing. There are now over 150 titles available,including a wide variety of Classical, Popular and Jazz discs. Hear "The Empire Strikes Back" by John Williams, Vivaldi's "Four Seasons" and artists such as Oscar Peterson, Dave Brubeck and Almeida.

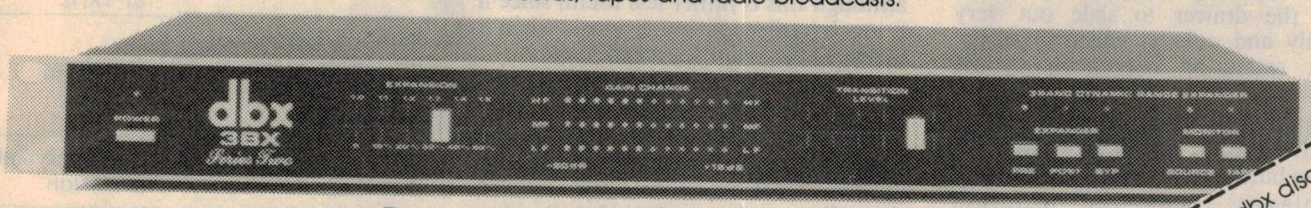
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# Realistic CD-1000 compact disc player

*Tandy Australia Ltd has entered the compact disc player market with its Realistic CD-1000. This has all the most wanted facilities in a neatly styled cabinet, all at a very reasonable price.*

**by LEO SIMPSON**

Tandy's new CD-1000 player is the first we have seen which has dispensed with the need for transport screws — those screws which are used to lock down the mechanisms of other CD players for transport. Just how Tandy have managed this, while other manufacturers still depend on them, is a mystery. But it is certainly a lot more convenient than having to store away essential transport screws.

The CD-1000 is one of the smallest players available currently, with dimensions of 320 x 307 x 87mm (W x H x D). It is also fairly light at 4.9kg, but it is in no way flimsy. It has a sturdy steel chassis and steel top cover, finished in a light grey enamel.

The front panel has a matt charcoal finish which sets off the white control legends well. The control layout is relatively simple and the facilities are largely self-explanatory. However, to use all the features you must consult the manual which is well written and easy to follow.

As with most current CD players, the CD-1000 is a front drawer-loading machine. Pressing the open/close button causes the drawer to slide out very smoothly and quietly, which gives the user a reassuring impression of the machine.

From there it is a simple matter to place the disc on the drawer platform, push the button again to withdraw it and the player reads the program information. This is then displayed after a second or two, on the bright white vacuum fluorescent 8-digit readout.

This digital display is highly legible but there is one problem with it, which is common on a lot of hifi equipment. The display is too deeply inset to be conveniently seen, unless it is virtually at eye-level.

The initial information displayed is the number of tracks and the total playing time. When in the play mode, the display shows the number and the time elapsed for the particular track. "Time remaining" to the end of the disc cannot be displayed on the CD-1000.

The basic controls comprise five push-buttons: Play, Pause, Fast-forward, Fast-reverse and Stop/Clear. The simplest playing procedure is to drop the disc into the open drawer and press Play. The drawer will then close and play starts at track number one.

By pressing Play and Fast-forward simultaneously, the player can be made to jump to the next track. Pushing Fast-forward by itself gives audible fast play in three modes. During the first four seconds, the music plays about twice normal speed and at reduced level; during the next four seconds, the CD-1000 jumps ahead, in steps of several seconds. Finally, the player will make much larger skips. After each skip, there will be a second or two of music and then another skip ahead.

The same mode of operation can be obtained with the Fast-reverse button although this is rather less useful since it is much harder to identify music when it is played backwards in small bursts!

At any time during play, one can select any other track to be played next by pressing one or two of the 10 programming buttons to obtain the desired track number (up to 99, depending on the number of tracks on a particular disc) on the display. Pressing Play will then select the wanted track.

You can also use the programming buttons to have the tracks played in any order. And having programmed in a particular sequence you can have it repeated ad infinitum by pushing the Repeat button.

The Repeat button can be used in other ways too. For example, you can repeat a whole disc just by pressing the Repeat button at any time during play.

Any musical phrase can be repeated too, just by pressing the repeat button twice, once at the start of the phrase and then again at the end. The CD-1000 is rather slow in this mode though, as it takes quite a few seconds to search back for the start of the phrase.

In operation, the CD-1000 is quiet and unobtrusive, which is as it should be. It is very difficult to hear it at all when it is playing normally, even if you listen to it very close to the cabinet. It does make a little more noise in the Pause and other non-play modes but this is at a very low level.

## Quoted Specifications

| | |
|---|---|
| Number of channels | 2 |
| Frequency range | 50-20,000Hz, ±0.5dB |
| Dynamic range | ≥93dB |
| Signal-to-noise ratio | ≥92dB |
| Channel separation | 86dB at 1kHz |
| Total harmonic distortion (incl. noise) at max. output level | ≤.004% at 1kHz |
| Wow and flutter | quartz crystal precision |
| D/A conversion | 16 bit with analog filter |
| Error correction system | Cross Interleave Reed Solomon Code (CIRC) |
| Audio output level | 2V RMS typical |




**The Realistic CD-1000 is the first we have seen which uses surface-mounting components.**

The rear panel of the CD-1000 is very spartan. There is just a pair of phono sockets for the output which is at a fixed level. Apart from labelling and the power cord, the rear panel is devoid of any other user features.

The unit is fitted with a two-core power flex and moulded two-pin Australian mains plug. It is a double-insulated appliance.

According to the labelling on the rear panel, the CD-1000 is "custom manufactured in Japan for Tandy Corporation." Just which company makes it Tandy is not saying although most of the key electronic components appear to be supplied by Hitachi.

Removing the top cover shows the CD-1000 to be a well-made machine although its design is quite different to many of the CD players we have seen so far. The biggest difference would appear to be in the design of the mechanism. Whereas other players have a swing balance mechanism which carries the laser pickup, the CD-1000 has a more rigidly fixed laser pickup which travels in a straight line. Maybe this is a clue as to how the manufacturers have been able to dispense with transport locking screws.

A large L-shaped printed circuit board accommodates most of the circuitry, with the remainder being on a vertically mounted board on the right-hand side of the chassis. This is the first piece of hifi equipment we have come across which uses surface mounting components. These are not mounted directly onto the main PC board but onto ceramic substrate boards similar to those used for hybrid integrated circuits.

In all, there are four of these substrate boards in the unit and they appear to be multi-layer circuits. Three are small vertical boards carrying chip resistors, capacitors and transistors plus conventional dual in-line ICs. At the rear of the main PC board is the other larger substrate board which has three chip carrier packages and one conventional 40-pin IC. Fascinating.

Tandy do not state, in the owner's manual, just what system of digital-to-analog conversion and filtering is used in the CD-1000 but as far as we can judge from the test results, they have used a straight 16-bit system without over-sampling and with multipole analog filtering.

## Performance tests

For most of the performance tests we used the Technics SH-CD001 test disc in conjunction with Sound Technology test equipment.

The first check was for overall linearity. This is carried out using a 1kHz tone which is stepped down in 10dB steps to −90dB. As with most CD players the Realistic unit was pretty good in this respect although not quite as good as some we have tested.

The linearity results were: close to zero error down to −60dB; +0.5dB error at 70dB; +2dB error at −80dB and +5dB at −90dB.

Frequency response was ruler-straight up to 16kHz, dropping by 0.5dB at 18kHz and 1dB at 20kHz. The signal voltage at 0dB level is 2.4V RMS and the overall signal-to-noise ratio was 101dB unweighted, making the CD-1000 one of the quietest units we have tested so far.

Just for interest we also measured the mute level, which occurs while the machine is in Pause or one of the other non-play modes. The measurements proved to be −103dB in the right channel and −110dB in the left channel.

Total harmonic distortion over the whole audio bandwidth ranged from .005% to .009% from 20Hz to 18kHz which is good but at 20kHz it rose to 0.25%. This last measurement proved to be a furphy as it was a beat product at 24.1kHz. This is the difference between the sampling frequency of 44.1kHz and the signal frequency of 20kHz. This is a common result in CD players but is not audible in the slightest.

Measurement of separation between channels resulted in readings of −87dB at 100Hz and 1kHz, −85dB at 10kHz, and −77dB at 20kHz for the left channel. Equivalent figures for the right channel were 90dB at 100Hz, 91dB at 1kHz, 88dB at 10kHz and 89dB at 20kHz. These figures are very good.

## Error correction

Since compact discs will inevitably collect scratches and abrasions as they are used, the error correction ability of a CD player is most important. We test this with the Philips No 4A test disc. And again, as with most of the newer generation players we have tested, the CD-1000 sailed through the entire disc without so much as a glitch.

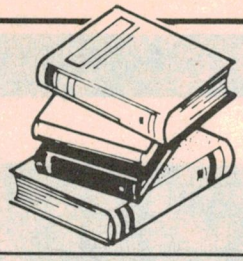
On the other hand, we also have a quite badly scratched disc which some players can handle without problems. The CD-1000 sometimes refused to read the contents of this disc and had problems playing some of the tracks. One track it would not play at all while two others were played with endlessly repeated phrases.

Perhaps this test is a little drastic but it does give a further guide to the error correction performance.

On the whole, the CD-1000's error

*Continued on page 120*

# Books & Literature



## Timer Circuit Data

**IC TIMER HANDBOOK with 100 projects and experiments: by Joseph J. Carr. Published by TAB Books Inc, USA, 1981. Soft covers, 130mm x 209mm, 308 pages. Illustrated with circuits and graphs. ISBN 0-8306-1290-4. Recommended Australian price $13.95.**

As the author himself admits the title of this book is not strictly accurate, because timer circuits using discrete components are dealt with, as well as IC types. This is mainly to help explain the basic principles of some timer circuits, but the circuits are practical ones, used extensively in the past.

The title may also confuse for another reason; the author uses the word timer in a very broad sense, treating oscillator circuits (correctly) as simply another version of a timer. In fact the book appears to have many more oscillator circuits than the more elementary timer configurations.

Most of the book is devoted to describing a very wide range of practical circuits built around an equally wide range of ICs. However, the first six chapters are devoted mainly to explaining the theory of timers and the oscillator circuit derived from them.

This is not completely successful because the author tends to use relatively advanced terminology while describing the most elementary circuits. He also assumes that the reader is as familiar with mathematical formulas as he is. In fact, the reader is not far into chapter one before he is likely to feel that he has been pushed in at the deep end.

In spite of this criticism the book is worth persevering with because it does contain a lot of useful information. Part of it (chapter 4) is almost a mini course in logic.

There are 17 chapters, under the following headings (abbreviated). (1) Bipolar ICs and op amps; (2) Discrete timers; (3) TTL and CMOS; (4) Digital Electronics; (5) The 555 Timer; (6) Monostable 555; (7) Astable 555; (8) XR-2240; (9) XR-2240 projects; (10) CMOS timers; (11) TTL timers; (12) Retriggerable timers; (13) Long duration timers; (14) Op amp timers; (15) Alarm projects; (16) More projects; (17) Still more projects. There are also three appendices.

Overall the impression is very favourable and any experimenter or student needing to update or broaden his knowledge of ICs, logic, timers, and oscillators could add this to his library with advantage. And, at the price quoted, it would seem to be good value.

Our copy from McGills Authorised Newsagency Pty Ltd, 187 Elizabeth St, Melbourne (P.G.W.).

## Personal Computing

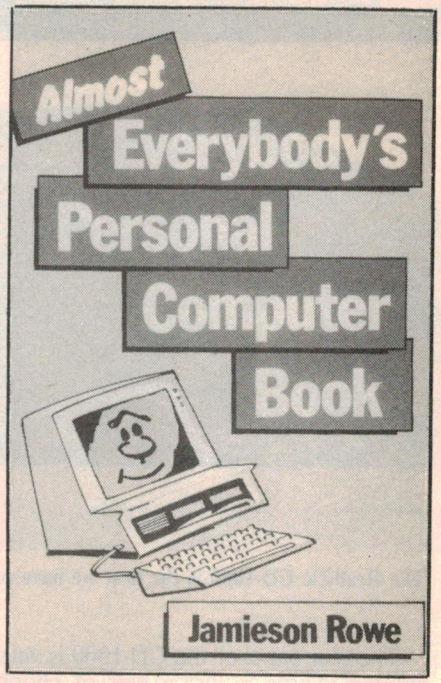
**ALMOST EVERYBODY'S PERSONAL COMPUTER BOOK: by Jamieson Rowe. Distributed by Horwitz Grahame Books Pty Ltd and Gordon & Gotch Limited, Australia. Soft covers, 135 × 213mm, 160 pages illustrated with photographs and drawings. ISBN 0 7255 1767 0. Recommended retail price $8.95.**

Written by the previous editor of *Electronics Australia,* this book was to have been titled, "What! Another book on personal computers?" but the publishers would not have it. The more prosaic title actually used does not convey the flavour of the text quite as well.

Author Jim Rowe was well aware that many books on computers do little to help the newcomer and he was determined to produce something which not only attempted to enlighten the reader but also to entertain; hence the proposed but rejected title.

No previous knowledge of computers is necessary to understand this text. Even so, the prose is not so elementary that it would put off the well-informed computer buff; while they will find nothing new in it they may find the way in which expresses elementary computer concepts a refreshing change.

There are twelve chapters. The first chapter gives some idea of the book's approach by its subtitle: "Computers are playback devices. Computers don't think; programmers do". It strips away the myths about computer intelligence and puts across the idea that behind all the ballyhoo, the computer is just another electronic appliance.




Chapter two then builds on this relaxed approach by talking about what a computer does and the concept of a computer program. Useful comparisons are made with tape recorders and player pianos using program rolls.

And so it goes. Software and hardware are explained in simple terms and then there is a more detailed description of memory and the CPU, bits and bytes and so on.

There are chapters devoted to the history of personal computers, applications, choosing personal computers and some elementary information on programming.

In summary, an easy-to-read book that will not frighten the newcomer. We recommend it.

Our copy came from Horwitz Grahame Books Pty Ltd, 506 Miller Street, Cammeray, NSW 2062. (L.S.).

## Electronics Reference

**THE NEW PENGUIN DICTIONARY OF ELECTRONICS: by Carol Young. Published by Penguin Books Ltd, Middlesex, England, 1983. Soft covers, 128mm x 198mm, 618 pages. Illustrated with line drawings, graphs and circuits. ISBN 014 OSI 074S. Recommended Australian price $9.95.**

Carol Young, the author of this dictionary, is an honours degree graduate, in physics, from Bristol University, and worked for six years in medical physics in London and Cambridge hospitals. She wrote the

electronics entries in the "Penguin Dictionary of Physics" and, in the compilation of this electronics dictionary, her husband, John Young, acted as consultant, having acquired many years experience in electronics research.

With a background like that one would expect the book to be a cut above the average; an expectation which would be fully justified. In any book of this kind there is always a conflict between how much to say about a particular subject — remembering that it is a dictionary and not a textbook — and how much space can be spared to say it, considering its relative importance.

In this respect the author appears to have done a particularly good job, entries ranging from one or two lines (dry joints) to around two pages for subjects like television. Frequent use is made of circuit diagrams, formulas, etc to aid the explanations.

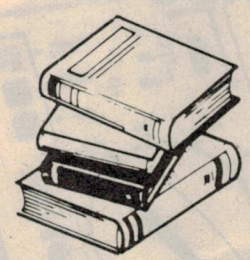
Another very useful feature is the identification, by means of an asterisk, of any words or terms which are defined elsewhere in the book, thus allowing the reader to expand his knowledge, where necessary, to cope with the explanation.

In fact, many of the explanations are at least as detailed as found in many textbooks, and a good deal more so than in some. At the same time, the book appears to be remarkably complete. (If the producers of the ABC's "Towards 2000" had wanted a better definition of Doppler radar than the one they gave in a recent program, they would have found it here!)

As well as the dictionary proper there is a set of very useful tables (15 in all) at the end of the book, ranging from circuit symbols, colour codes and SI units, to major discoveries and inventions and the Greek alphabet.

In short, a very very useful reference book for students, technical writers, technicians, or engineers who need to clarify a new term, or refresh their memory regarding an old one. Incidentally, the text is thoroughly up-to-date, in spite of what might be implied by the front cover illustration. At the price quoted it would appear to be very good value.

Our copy from Dick Smith Electronics (P.G.W.).




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ALA/ST5285/EA1284

# MAKE A GIFT FROM A KIT

The joy of giving is enhanced when they know you've made it yourself.

## HOUSE ALARM KIT - ETI 582

This great kit was released by ETI back in 1977. To make it easier for the constructor we have joined the two PCB's together and added a power supply on the one board.

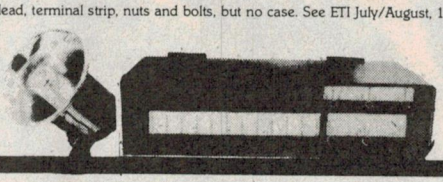
**SPECIFICATIONS**

**Types of inputs** Silent entry, perimeter circuits, internal circuits, emergency circuits.
**Silent entry** Single circuit, 30 second exit delay, 30 second entry delay.
**Perimeter circuits** 7 circuits, N/C contacts can be expanded in units of 4.
**Internal circuits** 4 circuits, N/C contacts, can be expanded in units of 4. Any number of N/O circuits.
**Emergency circuits** Any number of N/O circuits. These circuits are active even if perimeter and internal circuits are switched off.
**Current drain and battery life (type 732)** Emergency only 2.5mA (4000 hours); Alarm active 9mA (2000 hours); Alarm sounding 500mA (10 hours)
**Alarm time** 12 minutes

All components are supplied, including mains transformer, lead, terminal strip, nuts and bolts, but no case. See ETI July/August, 1977.
Cat. KE-4032

**ONLY $59.95**

**(HORN EXTRA)**



## MICROBOTS® BACK!!

We have secured another shipment of the two most popular Micro Robot kits.

### PIPER MOUSE

This 'microbot' is powered by 2 DC motors that drive wheels. When special ultrasonic whistle is blown, the unit goes left, right, straight ahead according to your command. Complete, including perspex dome cover! Be a Pied Piper!
Cat. KJ-6680

**$34.95 - SAVE $5.00**

### MEMOCON CRAWLER

This robot is controlled by a keyboard (which is supplied). The keyboard plugs into the robot. Up to 256 discrete commands can be entered into the robots memory (RAM). The robot will then move according to programmed instructions. Lights and a buzzer can also be programmed to operate as well.
Cat. KJ-6686

**$69.95 - SAVE $10.00**

**SEE REVIEW IN ELECTRONICS AUSTRALIA MARCH 1984**



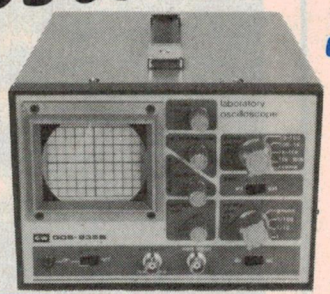
*Ref: EA October 1984*

Jaycar and EA have come up with the best value Oscilloscope on the market today - **IN A KIT. . .**

## OSCILLOSCOPE SENSATION!

Over the years many people have asked, "Do you have a CRO kit?" Our answer - up until now - has been that built and tested units were no dearer than kits, if you could get a kit at all.
The Jaycar KJ-7050 Cathode Ray Oscilloscope kit has a guaranteed 5MHz bandwidth but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz 'scope is usually adequate to troubleshoot most micro processor and other digital circuitry as well!
This is a wonderful opportunity to learn electronics AND end up with a valuable piece of test equipment as well.
The Jaycar KJ-7050 kit is absolutely complete. The chassis is pre-punched and every component including nuts and screws are provided, along with instructions.
**Cat. KJ-7050**

**ONLY $229**



## MUSICOLOR IV

REF: EA AUGUST 1981

The ultimate in lighting controllers. Combines a brand new four channel version of the famous EA Musicolor sound-to-light effect with four channel chaser. This new Musicolor has a host of features rarely seen even on expensive commercial units: ★ Front panel LED display ★ four different chaser patterns ★ auto and manual reverse chase ★ sound-triggered chase ★ inbuilt electret microphone ★ safe, opto-isolated circuitry. And just look at the price!
Cat. KA-1010

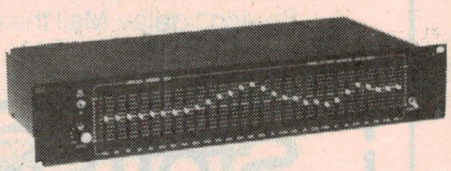
**$89.90**




## ⅓ OCTAVE EQUALISER - the way to go

Rugged full ⅓ Octave Equaliser in a 19" rack mount case with Cannon Male/Female connections for full professional use. The Jaycar 2801 Mk III has specifications that are unknown in equalisers under the $1,000 price tag! Now is the time to bring your music presentation up to grade with the unsurpassed Jaycar 2801 Mk 111 (very similar to the 5000 ⅓ Graphic Equaliser).
Cat. KJ-6531

**FROM $225**



## KAISE DIGITAL MULTIMETER SK 6100

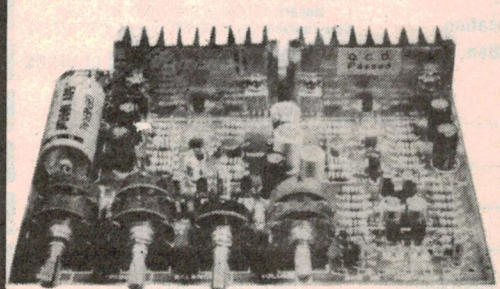
Check the specifications/features of this superb Digital Multimeter.

- Autoranging with manual override
- Auto polarity displays - sign when probes reversed
- Overange indication "Blink" and buzzer warning
- Low battery warning BATT sign shows
- Sampling rate 2 times second
- Power supply 2 x A penlight batteries (300 hours continuous operation)
- Fuse protected, spare fuse provided
- Zero adjustment, zero adjust button - a must if you change test probes
- LCD display, magnificent clear readout
- Inbuilt buzzer, available for continuity test, overload warning and switch warning
- Ranges ±1000V DC/600V AC, AC and DC current, resistance 200 (resolution 0.1 ohm) to 2000K ohm (resolution 1K ohm) in 5 ranges autoranging
- Accuracy 0.5% DC, 0.8% AC

Cat. QM-1525

**$59.95**



## 30W + 30W STEREO PREAMPLIFIER

★ **Fully built and tested** ★ **Separate Bass, Treble, Balance and Volume controls** ★ **Less than 0.1% distortion** ★ **Mic, Phono and Aux inputs (line)** ★ **Power supply components on board.**

Back at last! No hassle amplifiers. Just connect a transformer, speakers a signal and you're away!

***STAGGERING VALUE***

**ONLY $39.95**

Cat. AA-0300




**FULL 90 DAY WARRANTY**

**★ NEW IMPROVED MODEL ★**

As reviewed in Electronics Australia Oct 1982 & Electronics Today International Nov 1982

Cat. XC-2010

At $199 the Voyager Car Computer represented outstanding value for money. The Voyager is the only low-cost unit that will give youfuel consumption (the most important feature in a car computer) in both metric litres/100km AND good old MPG! At $199 many, many hundreds have been sold. NOW you can grab one absolutely complete for only $125 - a saving of 37% or $74! The Voyager comes complete with all fitting hardware - even down to a roll of insulation tape! Installation generally takes between 4 and 6 hours depending on vehicle.

**SPARE FLOW SENSORS** To avoid problems when changing cars, why not buy a spare fuel flow sensor? They are about the only thing that can wear out.

Cat. XC-2036 ONLY **$29.50**

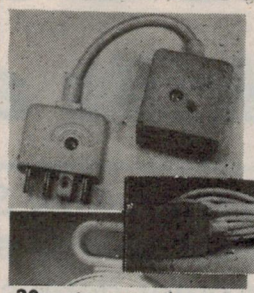
The Voyager is available from the following dealers at your convenience.
**★ ALL JAYCAR STORES AND BY MAIL ORDER: JAYCAR P.O. Box 480 Auburn 2144 ★ ZAP ELECTRONICS (all stores) ★ ROD IRVING (Melbourne 347 9257 or Northcote 489 8131 ★ ALTRONICS (Perth 328 1599)**

**ONLY $125 COMPLETE**

*MASSIVE SAVING OF $74*

**BELOW MANUFACTURER'S COST!!**

# AT LAST! LOW COST TELEPHONE EXTENSION CORDS!



**Telephone socket double adaptor**

Cat. YT-6020 **$19.95**

Suitable for PABX (10 metre length)



**20 metre extension cord**

Cat. YT-6014 **$24.95**



**10 metre extension cord**

Cat. YT-6012 **$19.95**

**5 metre extension cord**

Cat. YT-6010 **$14.95**

# 80 CPS Printers Are Out!! The New Micron 100 CPS is in




**$379**

FEATURES: ★ Extra fast 100 characters per second ★ 192 ASCII characters (96 standard, 96 italic) ★ Bit image graphics ★ Friction and sprocket paper feed (100mm to 254mm paper) ★ Columns - normal/80, condensed/142, enlarged/40, condensed double width/71, elite/96, enlarged elite/48, ★ Logic seeking - bidirectional.

Cat. XP-4630

# SCOOP PURCHASE of 4 COLOUR PRINTER/PLOTTERS!!

**DON'T PAY**

~~$299~~

~~$229~~

~~$169~~

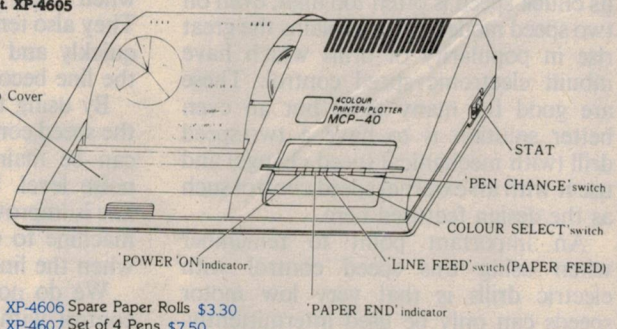
**$149**

Cat. XP-4605

Jaycar has done it again! We have made a scoop purchase of 4 colour printer/plotters at a never-to-be repeated price!! The SAME printer has sold elsewhere for up to **$299** but currently sells for as low as $169. At $169 it is an absolute bargain! (See specs). Now Jaycar can offer you the SAME printer for $149!!How do we do it? We have bought BELOW IMPORTERS COST and have passed the SAVINGS on to you!

QUANTITIES STRICTLY LIMITED. We have less than 80 pcs in stock at the time of going to press. To avoid disappointment, we suggest that you ACT QUICKLY.

The printer/plotter is supplied with mains lead, a roll of paper 114mm x 55m long (4.5" x 180') and a set of 4 pens (black, blue, red & green). Spare rolls and pens are available from other major electronic suppliers and for a short time, us




Cat. XP-4606 Spare Paper Rolls $3.30

Cat. XP-4607 Set of 4 Pens $7.50

# Sparkrite

The Brandleaders in Auto Electronics

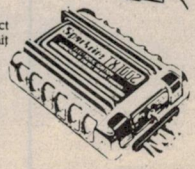
## SPARKRITE SX2000 ONLY $59



Reactive Discharge electronics combining all the advantages of both Inductive and Capacitive Discharge for maximum spark performance. Fits all 12V negative earth vehicles utilising coil and contact breaker ignition.

Cat. KJ-6650

## SPARKRITE TX1002



An Inductive Discharge System which can be used with existing contact breakers or with the Hall Effect Triggerhead system. A top quality unit from the U.K.

Cat. KJ-6651

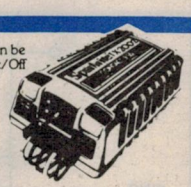
**ONLY $79**

## SPARKRITE TX2002

A Reactive Discharge System with unique auxiliary circuit which can be switched in via the three position switch on the unit itself - Electronic/Off /Aux'. Only four connections are necessary and it's fitted!

Cat. KJ-6652

**$115**



## SPARKRITE AT-80 VALUE AT $99



This unique alarm does not need holes to be drilled in your cars body - a special sensor pad is attached to the inside of your windscreen and you gain entry through your own programmed magnetic key fob. The sensor pad even flashes a light when your code has been accepted and the code can be reprogrammed at any time.

Cat. KJ-6660

**EA WIDEBAND AM TUNER** - Ref: EA Dec/Jan 1982/1983

This is a true broad-bandwidth superhet design AM tuner kit suited most admirably to Australia. Jaycar have produced a superb kit that includes a pre-punched cabinet.

Cat. KA-1498 **ONLY $249**

**Alignment kit for EA Tuner** - Cat. KA-1515 **ONLY $7.95**

**CQAM STEREO DECODER KIT** - Ref: EA October 1984

Set of parts for this project including PCB, 10uH choke, MOC13020 IC. (Whistle filter coil extra - Cat. EE-3814 ONLY $19.95)

Cat. KA-1555 **ONLY $19.95**

**Jaycar ELECTRONICS**

SEE PAGE 119 FOR ADDRESS PANEL AND OTHER INFORMATION

# Speed Controller
## for drills and lawn edgers

*This simple and refined SCR circuit can be used to control the speed of electric drills, lawn edgers and other domestic appliances using "universal" brush-type motors.*

**by LEO SIMPSON**

Our new speed control circuit provides a large range of useful speeds, as much as 10 to one with some of the better electric drills. With the control adjusted for the lowest usable speed, your electric drill can even be used as a screwdriver which is handy if you are doing a lot of repetitive work.

These days any self-respecting handyman (handyperson?) would be lost without such a basic tool as an electric drill. The electric drill can be used for many tasks besides the obvious one of drilling holes. It can also be used to drive small impeller pumps, stir paint, and even polish the family car.

As versatile as the electric drill may be, its chuck speed is often too high, even on two speed models. This explains the great rise in popularity of drills which have inbuilt electronic speed control. These are good for many tasks but an even better solution is to have a two-speed drill (with mechanical speed change) and use it with an external speed control such as the design featured here.

An important point to remember when using this speed control with electric drills is that very low motor speeds can only be used intermittently. This is not because of any limitation on power dissipation within the controller but because of temperature rise within the drill motor itself.

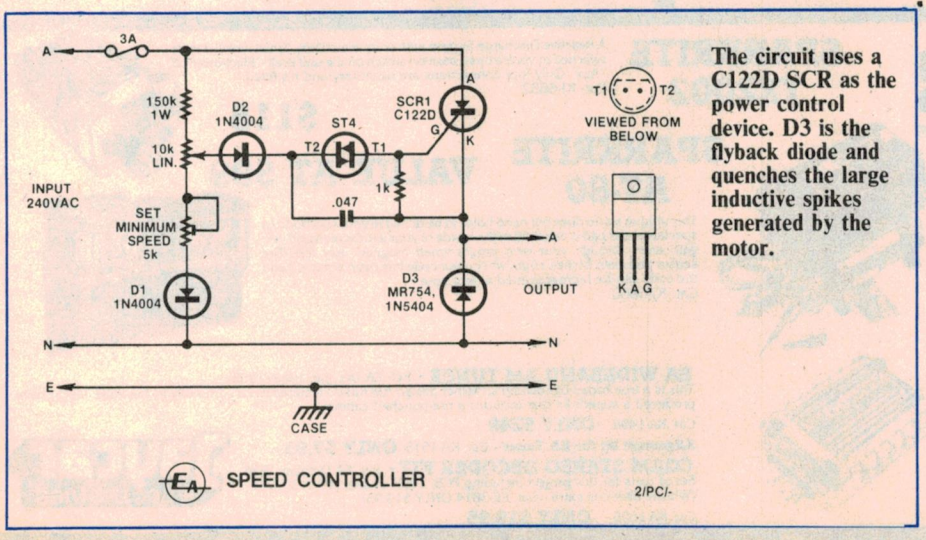
The problem is that when the motor runs at low speed its inbuilt fan becomes ineffective. With no airflow to cool the armature and field windings, the motor could overheat.

So if you want to use your electric drill at very low speeds, do it only for short periods.

Another very useful application of this new speed control is with the larger electric lawn edgers such as the "Weedeater" for example. These very efficient machines tend to be quite noisy when used at the full mains voltage. They also tend to wear out the nylon line quickly and vibrate more noticeably as the line becomes shorter.

By using the bigger lawn edgers with the speed control adequate cutting power can be maintained while reducing the noise level. Wear of the nylon cutting line is improved and the tendency for the machine to scream at very high speeds when the line is short is also reduced.

We do not advocate using the speed control with the smaller types of lawn edgers. These toy-like units have barely enough cutting power as it is so the speed control would not be justified.




**The circuit uses a C122D SCR as the power control device. D3 is the flyback diode and quenches the large inductive spikes generated by the motor.**

### How it works

Now let us have a look at the operation of the circuit. It is basically a refined version of a circuit presented in the July 1976 issue of *Electronics Australia.*

As already mentioned, the basis of the circuit is a silicon controlled rectifier or SCR. This device is also sometimes referred to as a thyristor. An SCR can be regarded as a rectifier diode which only conducts in the forward direction when it is triggered by a small positive voltage applied between gate and cathode.

Once it is triggered into conduction it stays that way until the current either drops to zero or the voltage from anode to cathode is reversed.

When it is used with an AC voltage supply an SCR can be used as a very efficient power control device. We can control the point on the positive half-cycle of the waveform when the SCR goes into conduction quite simply. By triggering the SCR early in the half-cycle, we get higher power delivered to the load; by triggering late in the cycle, low power is the result.

The method is referred to as phase control since the SCR trigger point is controlled with respect to the phase of the AC supply voltage.

Refer now to the circuit. This uses two diodes and two four-layer semiconductor devices. One is the SCR, C122D, while the ST4 is an asymmetrical trigger device.

The ST4 is primarily intended for use in light dimmers where it provides phase control trigger pulses for a Triac. In this Speed Controller circuit we are using it for a similar function.

To explain further, the ST4 is a breakover device similar to a Diac. When voltage is applied to a breakover device (such as the ST4 or Diac) no current flows until the "breakover" level is reached. At this point, the device drops to a low resistance.

The ST4 is asymmetrical. In one direction it has a breakover voltage of about 16 volts from which it breaks down with a relatively high impedance with a conduction voltage of about 8 volts; in the other direction it has a

breakover voltage of about 8 volts and a low conduction voltage of about 1½ volts. We use it in this circuit in the latter mode only so that it is equivalent to a Silicon Unilateral Switch (SUS).

Our circuit uses the ST4 as a trigger pulse generator for the SCR. A .047μF capacitor is charged from the wiper of the 10kΩ pot via diode D2. When the voltage across the capacitor rises above the 8 volt breakover threshold of the ST4 it breaks down and delivers a short high-current pulse to the SCR gate and thus triggers it into conduction.

## Speed regulation

When you come down to basics, speed regulation is the purpose of this circuit. We want a preset speed to be maintained in spite of variations in load on the motor. This circuit provides quite good speed regulation (especially at the lower settings) by monitoring the back-EMF of the motor.

Note that there are actually TWO different back-EMFs from the motor: one present during the conduction periods of the SCR and the other present during the negative half-cycles and the early part of the positive half-cycles before the SCR is triggered into conduction. It is this latter back-EMF which controls the firing point of the SCR.

How the circuit monitors the motor back-EMF (and thus its speed) is as follows. The voltage applied by the 10kΩ pot wiper is not the effective charging voltage for the .047μF capacitor. Because the motor is connected in series with the SCR cathode, the back-EMF generated by the motor is effectively subtracted from the capacitor charging voltage.

Thus we have negative feedback from the motor, which will act to maintain the speed despite variations in load.

As the motor back-EMF rises with increasing speed, the effective capacitor charging voltage is reduced, so that the SCR is triggered later in the positive half-cycle. Thus less power is supplied and the motor speed tends to come back to where it should be.

Similarly, if the load on the motor increases, the speed will tend to reduce and the back-EMF will be reduced in proportion. This increases the effective capacitor charging voltage so that the SCR is triggered earlier in the positive half-cycle. Thus more power is delivered to the motor to maintain the selected speed.

The 5kΩ trimpot in series with the 10kΩ potentiometer sets the minimum speed of the motor. It should be set to give a speed at which the motor will run without "cogging".

So far we have not mentioned the three diodes in the circuit. D1 reduces the power dissipation of the series resistor chain by half and protects the SCR gate (and ST4) if the load is open circuit, as for example, when the motor is switched off. D2 protects the gate of the SCR when it is in the conducting state.

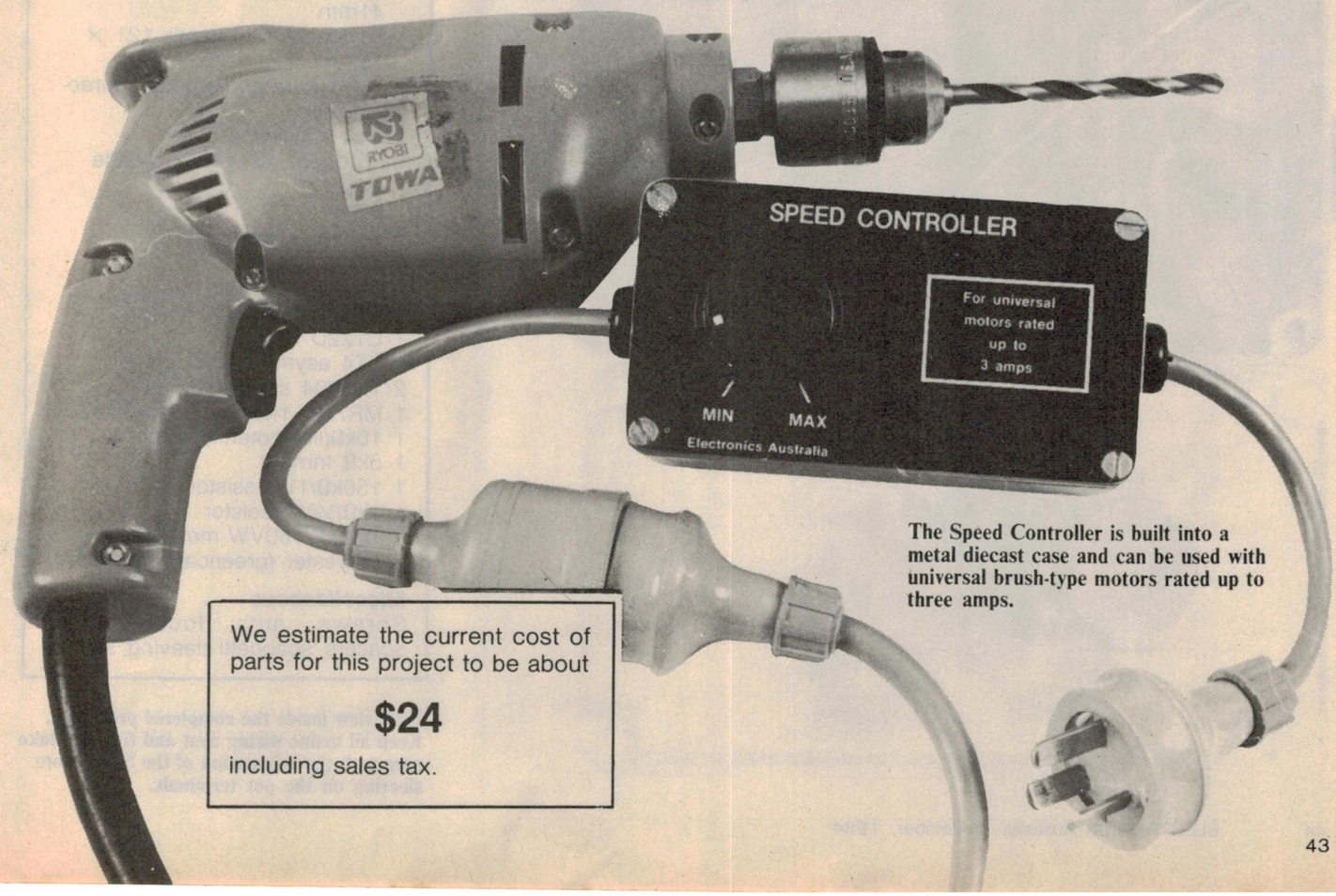
D3 is the flyback diode and is a refinement to the circuit published in July 1976. Its purpose is to quench the large inductive spike generated by the motor at the end of each positive half-cycle. This spike is an inevitable result of the SCR turning off at the end of the cycle. While the spike voltage causes no harm to the circuit it is so large that it tends to upset the back-EMF monitoring system described above.

With D3 in the circuit, operation at low speeds is improved. It is a refinement which can be added to the design featured in July 1976 together with the following modification.

As originally presented, without D3, the circuit is fail-safe. That is, if the SCR goes open or short-circuit, no safety hazard will be created, since the electric drill, or whatever, can be assumed to have its own on-off switch.

However with D3 in circuit it is no longer fail-safe. If either D3 or the SCR were to short-circuit, heavy currents would flow until the fuse in the domestic power circuit blew. To prevent this, we have added a three-amp fuse.

The 1kΩ resistor between gate and cathode of the SCR is often omitted from similar speed control circuits but it is recommended by the SCR manufacturers. It reduces the possibility of false triggering due to leakage and dv/dt




**The Speed Controller is built into a metal diecast case and can be used with universal brush-type motors rated up to three amps.**

We estimate the current cost of parts for this project to be about

**$24**

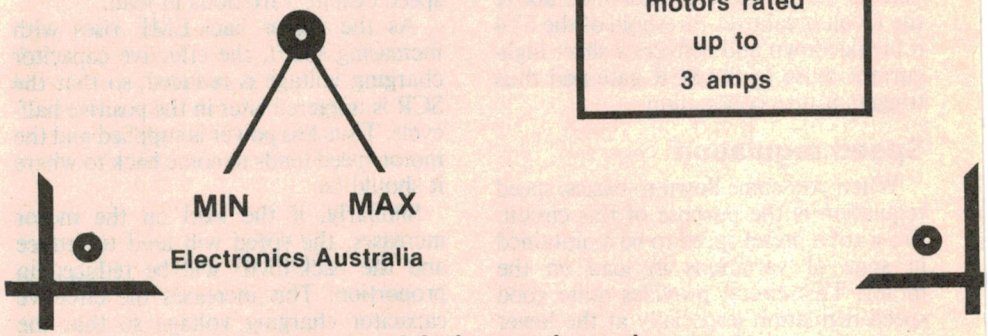
including sales tax.

effects and consequently lessens the chance of catastrophic failure in the device.

The SCR specified for the circuit is the General Electric device, C122D. This has a DC rating of 8 amps and a blocking voltage rating of 400 volts. As an alternative, the C122E rated at 500 volts may also be used.

With the C122D (or C122E) in circuit, the controller is suitable for electric drills or appliances with "universal" brush-type motors having nameplate ratings up to 3 amps. With motors of this rating or less, the SCR will be able to withstand the "locked rotor" current if the motor is stalled.

Note that we have not provided for a bypass switch on the controller. A bypass switch allows the drill or appliance to be used at the full 240VAC. We have not added this feature for two reasons. First, it does not appear to be necessary in practice. Second, if the unit is switched from 240VAC to the control mode while the motor is running, the very large voltage transient generated will blow the SCR.




**Here is an actual size reproduction of the front panel artwork.**

## Construction

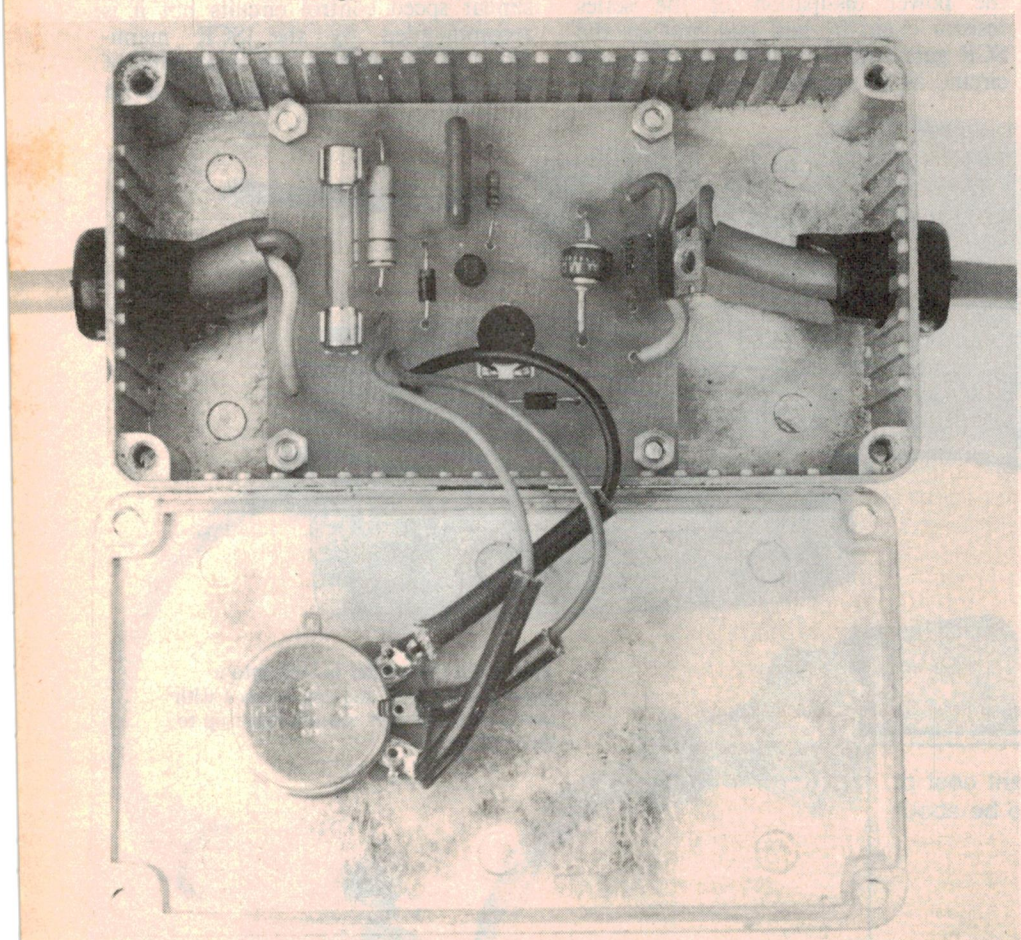
We built the prototype speed controller into a sturdy diecast box measuring 121×66×41mm. This is fitted with short mains cords, one with a three pin plug and the other with an in-

**Do not attempt to use the speed controller with an induction motor. It will not work and the motor may burn out.**

### PARTS LIST

1 diecast metal box, 121 × 66 × 41mm
1 Scotchcal front panel, 121 × 65mm
1 mains cord and moulded three-pin plug
1 mains in-line socket
1 PC board, 60×66mm, code 84sc11
1 knob
2 cord-grip grommets
1 solder lug
1 3-amp 3AG fuse
2 PC-mounting fuse clips
1 C122D SCR
1 ST4 asymmetrical trigger
2 1N4004 silicon diodes
1 MR754, 1N5404 silicon diode
1 10kΩ(lin) potentiometer
1 5kΩ trimpot
1 150kΩ/1W resistor
1 1kΩ/¼W resistor
1 .047μF/160VW metallised polyester (greencap) capacitor

***Miscellaneous***
Screws, nuts, lockwashers, spacers, spaghetti sleeving, solder.



**Left: view inside the completed prototype. Keep all mains wiring neat and tidy and take care with the orientation of the SCR. Note sleeving on the pot terminals.**

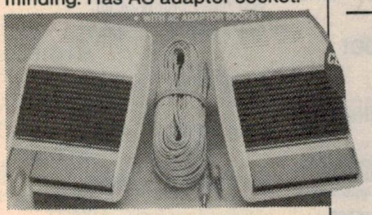


# A Sackful of Goodies from 'You Know Who'

**Wishing our customers new, old & potential, Xmas greeting and best wishes for 1985**

## Super Sound Intercom

Perfect for home or office. This completely self contained two station intercomcomes complete with 20 metres of connection cord. It has call facilities even when turned off. Ideal for baby minding. Has AC adaptor socket.



**only $11.95**

## FM Wireless Intercom – Xmas Bargain

Superb performance, and you don't have to wire it in! May be used in an intercom 'net' with other units.

★ Mains powered
★ Three frequency channels (switch selectable)
★ 2 units supplied

If you want an expandable system, this is the one to go for.



**SAVE FOR XMAS!!**

**only $55.00**

## Capacitors for Peanuts

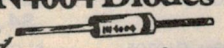


Giveaway bargains on top quality polyester (redcap) capacitors.

**.1uF/160V**
**only $4.00 per 100**
**.39uF/160V**
**only $5.00 per 100**

**100 of each $8.00**

## IN4004 Diodes



**50 for $2.50**

## 4864-2 Memory at Unforgettable Prices



Scoop purchase of top quality Hitachi 4864-2 (4164) 64K x 1 dynamic RAMs. These are prime spec 150nS devices so be quick at this price.

**only $7.00** (any quantity)

## IN914 Diodes – Xmas Clearout



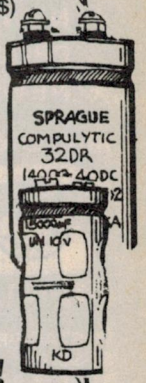
We've dropped the price of IN914 (IN4148) signal diodes for Xmas. Buy up quick. This month only.

**only $2.50 for 100**
**$20.00 for 1,000**

## Computer Grade Electros at Prices to Smooth you out!!

We have landed a shipment of top quality Philips, Sprague and Sangamo Electros. Best quality, best prices.

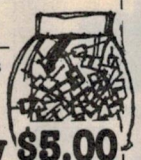
| Cap (uf) | Volt | Dia (mm) | Hght.(mm) | Make | Price ($) |
|---|---|---|---|---|---|
| 500 | 250 | 35 | 80 | Sprague | 5.00 |
| 2400 | 50 | 35 | 55 | Sprague | 4.00 |
| 9100 | 60 | 50 | 110 | Sangamo | 10.00 |
| 10000 | 40 | 50 | 90 | Sprague | 6.50 |
| 14000 | 25 | 50 | 85 | Sprague | 5.50 |
| 14000 | 40 | 50 | 110 | Sprague | 9.00 |
| 22000 | 10 | 35 | 117 | Philips | 6.00 |
| 30000 | 25 | 65 | 85 | Sangamo | 13.00 |
| 33000 | 16 | 50 | 120 | Philips | 12.00 |
| 39000 | 30 | 50 | 140 | Sprague | 13.00 |
| 47000 | 25 | 65 | 120 | Philips | 19.00 |
| 88000 | 10 | 50 | 145 | Sprague | 14.50 |
| 10000 | 10 | 65 | 115 | Philips | 13.00 |
| 120000 | 15 | 65 | 145 | Sprague | 18.00 |




**LAST QUANTITIES REMAINING!!**

## MONSTER PACKS ARE BACK!!

### ½kg of Capacitors



That's right, an incredible half a kilo!! huge variety of types – perfect for the spares box. Polyester, ceramic, you name it, there's probably one in this pack!!

**only $5.00**

### 30 Assorted Pots



Slide, rotary, stacks of values. Perfect for replacement. Worth over $50.00

**only $5.00**

### Monster Trimpot Pack



100 mixed values. Normally selling for 30 – 50c each! Grab them while they last!!

**only $5.00**

### Servo Motors at Santa Prices

**48V**
★ 48V operation
★ 3650 RPM
★ 4.4A
★ 55oz/in continuous torque



**$50.00**

**24V**
★ 24V operation
★ 3650 RPM
★ 4.7A
★ 25oz/in continuous torque



**$45.00**

**12V**
12V operation
★ 3300 RPM
★ 5.0A
★ 16oz/in continuous torque



**$40.00**

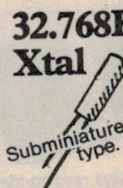
### Leading Lead Specials



We're clearing out leads for Xmas. Look at this bargain. You get 1 each of the following:
1) 3.5mm jack to 5 pin DIN plug (6ft lead)
2) 4 x 6.5mm jacks to 5 pin DIN plus (6ft lead)

**only $2 the pair**

### 32.768KHz Clock Xtal



Subminiature type.

**only $1.25**
**10 for $11**
**100 for $100**

### 3RPM Precision Motors Under Wholesale



Superb quality Crouzet geared motors. 3RPM (clockwise). Limited quantities.

**only $50**

### 150 ohm/25W Wire Wound Rheostat



Going at absolute giveaway prices for Xmas. Ceramic body. ¼" shaft. Perfect for speaker attenuators, power supplies etc. (Note: does not include knob)

**only $1.00**

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|---|---|
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| $50.00-$99.99 | $7.00 |
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**Large and overweight items sent skyroad freight**

**Trading Hours:**

| | |
|---|---|
| Mon-Fri | 9am-5.30pm |
| Thurs | 9am-7pm |
| ★Saturday | 9-1pm |

**(until further notice)**

Note: We accept both Bankcard and American Express. However we cannot give quantity discounts on Credit Card purchases or account orders. Minimum for account orders is $50.00
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**exclusive** of postage and packing

All prices include sales tax.

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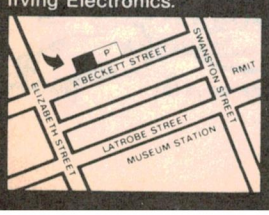
| | |
|---|---|
| $1-$9.99 | $1.50 |
| $10-$24.99 | $2.00 |
| $25-$49.99 | $3.00 |
| $50-$99.99 | $3.50 |
| $100-$199 | $5.00 |
| $200-$499 | $7.50 |
| $500 plus | $10.00 |

Certified Post for orders over $100 included "free"! Registered Post for orders over $200 included "free"! Account orders from schools Govt. Depts., Public Cos., gratefully accepted. Min. order of $20. (or a min. $5 accounting fee will apply.) Comet Road Freight, Airmail etc. are extra.

welcome here

## HAVE YOU BEEN INTO OUR CITY STORE???

Conveniently located on the edge of the city where parking is easy! Over 4,000sq. ft. of an extensive range of products and great "in store" bargains . . . for those interested in computers we have a wide range on display upstairs. For good advice and a good price, see Rod Irving Electronics.



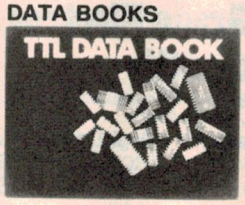

## SPOTLIGHT 12V



Quartz halogen spotlight. Hand held with moulded plastic grip. Brilliant beam up to 55 watts, can be seen for miles. Orange lens cover, emergency 'flasher' switch, 3 metre curled cord, cigarette lighter plug and replaceable H3 halogen bulb!

Cat. 15050 **$19.95**

## FAIRCHILD TTL DATA BOOKS




Just arrived! This book is the same as used in the Victorian Education System. Includes data on new Fast series. Limited stock 500 only.

Cat. B10050 **$14.95**

## NEGATIVE & POSITIVE CIRCUIT RESIST



Make your own presensitized PC Boards. POSITIVE PHOTO RESIST for using 1:1 tapes and pads on clear film for one off or prototypes. Resist:50ml bottle for apprx. 1500 sq cm of pcb.

Cat. P85500 **$6.95**

DEVELOPER: 70 gms of crystals to mix with 2 lt of water, enough to complement 50ml of resist.

Cat. P85504 **$3.25**

NEGATIVE PHOTO RESIST for using normal negative PCB images.
Resist : 50ml bottle for apprx. 1500 sq cm of pcb.

Cat. P85508 **$5.45**

DEVELOPER: 500ml bottle enough to complement 50ml of resist. No dilution reuqired.

Cat. P85510 **$8.50**

ETCHANT: 400gms of crystals to mix with 1 to 1½ lts of HOT water.

Cat. P85512 **$3.25**

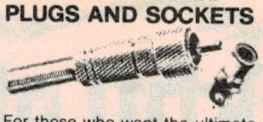
## ARISTA HOUSE ALARM




House alarm security system. Electronic push button control module with programmable entry/exit code. Supplied with siren module and 4 sets of reed switches. Will allow up to 30 entry/exit points and additinoal siren modules. Complete with instruction book, cable etc. Battery operated.

Cat. M22461 **$69.95**

## RCA GOLD PLATED PLUGS AND SOCKETS



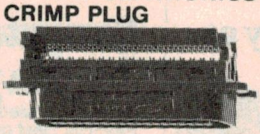
For those who want the ultimate in connection.
Essential for Laser disc player to get that fantastic sound quality.

Cat. P10147 PLUG **$1.95**

Cat. P10146 SOCKET **$1.20**

Please note these must be used together.

## 36 WAY CENTRONICS CRIMP PLUG



Cat. P12200

| 1-9 | 10-99 | 100+ |
|---|---|---|
| **$6.50** | **$5.95** | **$5.50** |

P.S. Discount flat cable is coming!
We've done it again!

## MINI STEREO HEADPHONE



Low cost hi-fi sound! Light and comfortable, as easy to wear as hair!

Cat. C14000 **$4.95**

## BULK CABLE 100M ROLLS



Cat. W11222 3C2V75 OHM **$25.00**

Cat. W11224 5C2V75 OHM **$39.00**

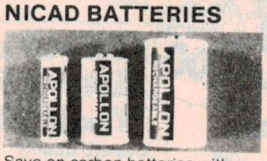
Cat. W11219 4 Core Shielded **$55.00**

## UNIVERSAL SOLDERING IRON STAND



Cat. T11302
**$5.95** slashed to **$3.95**

## NICAD BATTERIES




Save on carbon batteries with these Appolon Nickel cadmiums. Rechargeable up to 1000 times!

| | | 1-9 | 10+ |
|---|---|---|---|
| Cat. S150020 | AA500 MA | **$2.25** | **$1.95** |
| Cat. S15021 | C 1.8 AH | **$4.95** | **$3.95** |
| Cat. S15022 | D 4 AH | **$7.95** | **$6.95** |

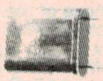
## RECHARGEABLE 12V GELL BATTERIES




Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

| | | |
|---|---|---|
| Cat. S15029 | 12V 1.2 AH | **$17.95** |
| Cat. S15031 | 12V 2.6 AH | **$34.50** |
| Cat. S15033 | 12V 4.5 AH | **$44.95** |

## CRYSTAL SPECIALS



Prime spec's. We just have too many in stock!

| | |
|---|---|
| 3.5795 MHz | 14.318 MHz |
| 4.00 MHz | 18.0 MHz |
| 4.1943 MHz | 20.0 MHz |

All **$2.50** each!
**10 or more $2.00!**

## PCB SPECIALS

Fibreglass predrilled boards.

| Type | Normally | Special Price for Mail Order Customers |
|---|---|---|
| 79TI11 | $ 3.90 | $1.90 |
| 80RM12 | $ 3.90 | $1.50 |
| 81DC2 | $ 3.50 | $1.50 |
| 81MI11 | $ 3.90 | $1.50 |
| 82 A03A/B | $11.80 | $5.00 |
| 82A03C | $ 3.90 | $1.50 |
| 82 VX4 | $ 3.90 | $1.95 |
| 821V5 | $ 5.90 | $3.50 |
| 821V6 | $ 9.50 | $5.95 |
| 82PC8 | $ 2.50 | $1.00 |
| 82AL11 | $ 3.90 | $1.95 |
| 83MS4 | $ 4.90 | $1.95 |
| 83PC3A | $ 3.90 | $1.35 |
| 83PC3B | $ 2.95 | $1.35 |
| 83RC12A/B | $ 4.05 | $2.95 |
| 83PS5 | $ 5.95 | $3.50 |
| 83PS7 | $ 2.95 | $1.10 |
| 83TT8 | $ 3.95 | $1.25 |
| 84MC5 | $ 3.95 | $1.95 |
| 84AU1 | $ 2.95 | $1.25 |
| 84AN3A | $ 3.95 | $1.95 |
| 84AN3B | $ 3.95 | $1.95 |
| 84SP3 | $ 5.90 | $3.10 |
| 84B4 | $ 6.95 | $3.10 |

P & P PCB's ONLY ... $1.00
"FREE" Floura Starter Kit with each order over $50.00.

## AUDIO FLANGER




Modulates a delay system and produces delay and pitch variations. Features 4 seperate controls producing an extremely wide range of effects from light chorus to really wild tones. At half the price of comparable units in music stores, these are great value!

Cat. A12044 **$89.00**

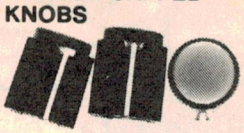
## AUDIO ANALOG DELAY




Achieves delays ranging from 20-300 milliseconds. Superb reverb, doubling and echo. Perfect when playing in 'DEAD' rooms/halls.

Cat. A12046 **$139.00**

## COLOUR CAPPED KNOBS



Economy knobs with elevated white pointer.

| | |
|---|---|
| Cat. H10001 | RED |
| Cat. H10002 | BLUE |
| Cat. H10003 | GREEN |
| Cat. H10004 | YELLOW |

This month's prices

| 1-9 | 10-99 | 100+ |
|---|---|---|
| $0.40 | $0.35 | $0.30 |

## BRAND NEW FANS

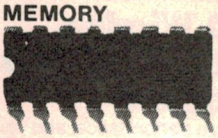


Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

| | | | |
|---|---|---|---|
| Cat. T12461 | 240V | 4⅝" | **$16.95** |
| Cat. T12463 | 115V | 4⅝" | **$16.95** |
| Cat. T12465 | 240V | 3½" | **$16.95** |
| Cat. T12467 | 115V | 3½" | **$16.95** |

10 Fans (mixed) less 10%

## INCREASE YOUR MEMORY



| | 1-9 | 10+ |
|---|---|---|
| Cat. U48116 4116 | **$2.95** | **$2.50** |
| Cat. U48164 4164 | **$7.95** | **$6.95** |
| Cat. U48770 27128 | **$49.00** | **$45.00** |

## ★★★ SCOOP ★★★

## PRIME SPEC RED LEDS

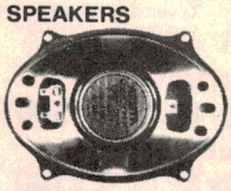


We bought 100,000 so you can reap the benefits!

| 1-9 | 10-99 | 100+ |
|---|---|---|
| **$0.10** | **$0.09** | **$0.08** |

Cat. Z10150

## CAR REPLACEMENT SPEAKERS



| | | |
|---|---|---|
| Cat. C10757 | 5x7" Oval | **$5.95** |
| Cat. C10746 | 4x6" Oval | **$4.95** |
| Cat. C10705 | 5" Round | **$4.50** |
| Cat. C10706 | 6" Round | **$5.95** |

All are rated at 4 OHM, 5 WATT

Errors and Ommissions Excepted

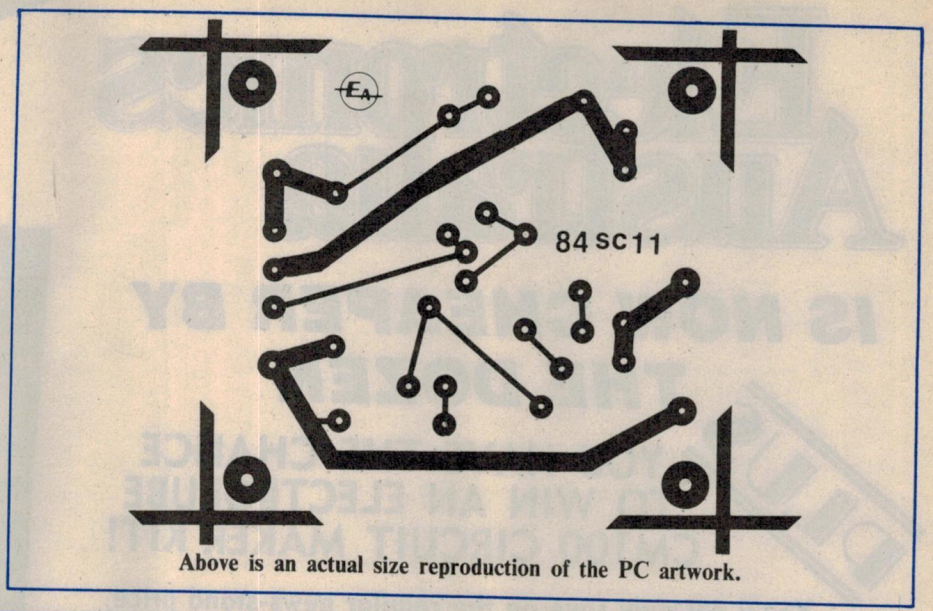
# Speed Controller

line socket which is the output of the device.

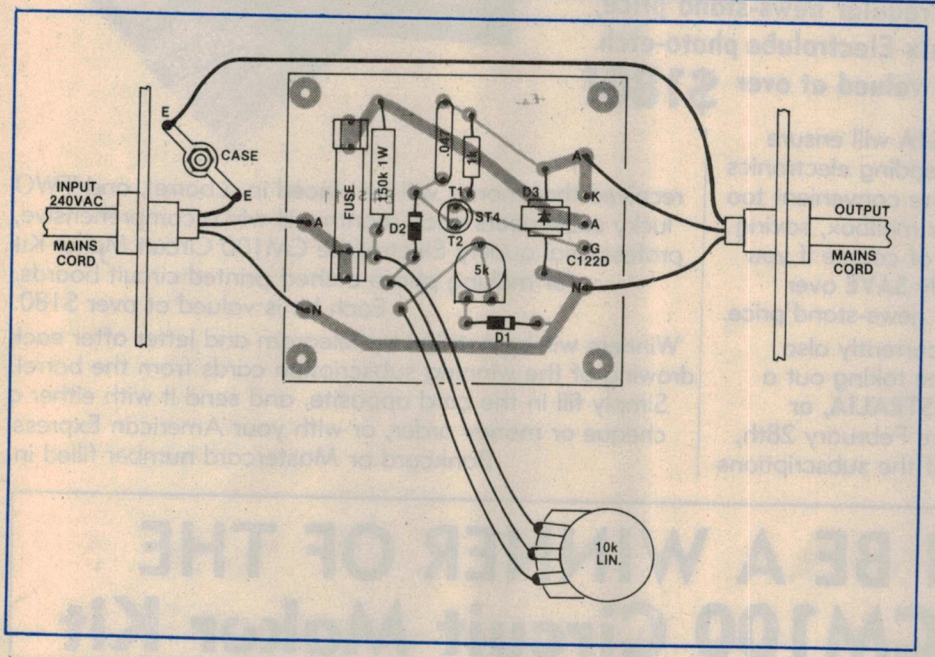
All the circuit components with the exception of the 10kΩ potentiometer are mounted on a printed circuit board measuring 60×66mm (code 84sc11).

The ST4 asymmetrical trigger device should be soldered in as shown in the wiring diagram. Incorrect polarisation will not result in damage but will cause ineffective speed control.

The C122D SCR is soldered directly into circuit and does not require a heatsink. Make sure that the SCR metal tab clears the lid of the case when the PC board is mounted.




**Above is an actual size reproduction of the PC artwork.**




**Left: follow this parts layout diagram when wiring up the Speed Controller. Do not omit the 3-amp fuse.**

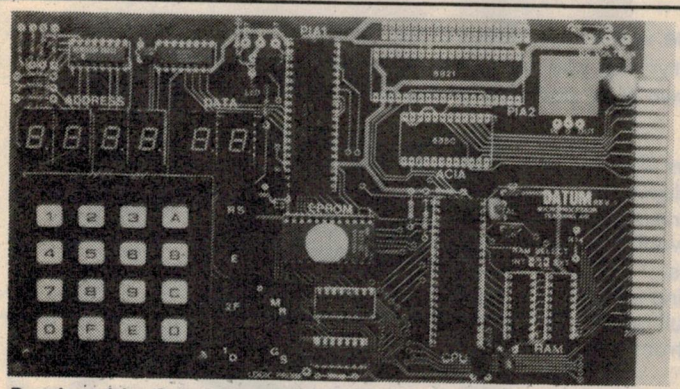
Either a 1N5404 or MR754 may be used for D3, the flyback diode.

Mount the board in the case using 6mm long spacers plus screws and nuts. The two power cords should either be secured using cordgrip grommets (fitted into the right size holes) or fitted more conventionally using grommets and suitable cord clamps.

The earth wires of both the mains input and output cords should be terminated to a solder lug on the case.

After checking all wiring carefully against both circuit and wiring diagrams, the unit may be tested on the mains with a drill as the load.

Note that setting the trimpot for minimum motor speed should be done with power off and the unit disconnected from the mains for safety's sake.

# DATUM

## The true starting point COMPUTER KIT

**$99⁰⁰ (ex. S.T.) P. & P. $5**

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**Developed by S.A. Institute of Technology to introduce students to the versatility of microprocessor systems. Featured in EA articles November, December, '82 and January '83.**

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In addition to this price saving, we're currently also making an exciting new offer to anyone taking out a new subscription to **ELECTRONICS AUSTRALIA**, or renewing a previous subscription before February 28th, 1985. At the end of each month, all of the subscriptions received that month will be placed in a barrel, and TWO lucky subscribers each month will win a comprehensive, professional quality Electrolube CM100 Circuit Maker Kit for making photo-etched printed circuit boards. Each kit is valued at over $180.

Winners will be notified by telegram and letter after each drawing of the winning subscription cards from the barrel. Simply fill in the card opposite, and send it with either a cheque or money order, or with your American Express, Bankcard or Mastercard number filled in.

## YOU CAN BE A WINNER OF THE Electrolube CM100 Circuit Maker Kit

The CM100 Circuit Maker Kit is the latest addition to the well-known Electrolube range of chemicals and service aids for the electronics industry. It contains virtually everything you need to make high quality printed circuit boards using the photo-etch method, from either your own tape patterns or from same-size printed layouts. No darkroom or camera is necessary.

*The kit contains the following:*

- 12 sheets of autopositive film.
- 6 double-sided fibreglass blank boards, all measuring 160 x 100mm (Eurocard size).
- Universal exposure and assembly frame.
- A Photoflood lamp.

*All necessary chemicals:*

- developers • fixer • film clearing solution • photoresist • copper etchant • and a combined soldering flux/protective lacquer
- A complete set of photographic dishes.
- A liquid measure.
- A retouching pen.
- A liquid-crystal thermometer.
- A couple of 1.1mm PCB drills.

*And all extras like:*

- Plastic gloves.
- A photoresist applicator.
- Cotton wool.
- Film clips.
- A scouring pad.
- And a full set of step by step instructions.



***NOTE: The above competition does not apply to readers in Queensland or South Australia, due to the laws relating to lotteries in those states.***
***NSW Lottery Permit No. TC84/2457***
***Victoria Lottery Permit No. 84/884***

# 50 and 25 years ago...

***"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.***




**December 1934**

**Launched by remote control:** The ceremony of the launching of the new Orient liner Orion at Barrow-in-Furness on Friday, December 7, is to be broadcast in the BBC Empire short-wave programs, and relayed through 4QG and 2FC.

The ceremony will be performed by the Duke of Gloucester who will be in Brisbane on that day. The Duke will press a button which, by remote control, will set the Orion in motion down the slipway. As she moves, a "tripper" will actuate automatically, which will break a bottle of empire wine against her bows.

The launching ceremony, will be heard by Empire listeners throughout the world as well as by the crowds at Barrow. Microphones installed along the slipway will pick up the sounds as the Orion takes the water.

Orion has a displacement of 24,000 tons, with a length of 664ft and a beam of 82ft. She will be driven by two twin screw turbines, with a horsepower of 27,000.

**Aerial beach patrol:** An entirely new radio service is to be inaugurated in Sydney on December 8, when 2UW is establishing a complete aerial patrol of the beaches between Mona Vale and Maroubra. An aeroplane, piloted by Mr E. V. Collibee, a member of 2UW's staff, will cover these beaches each Saturday afternoon and again on Sunday mornings and afternoons.

The aeroplane will be equipped with both transmitting and receiving equipment, so that all activities can be exchanged between the machine and 2UW's studio. The pilot will patrol each beach in turn. If he sights a shark he will immediately notify the studio which will then make an announcement to the beach concerned. The plane will meanwhile circle the beach.

Should a surfer be carried out to sea, the nearest surf club will immediately notify the studio which will, in turn, call the plane and direct the pilot to the beach. On sighting the surfer, he will swoop down and throw a pneumatic lifebuoy.

**Ministry of Truth?** "You have just come at the right time, because our new program has just arrived in connection with our Australian section." This information, and other points of interest, were told to "Wireless Weekly's" representative who was welcomed by the broadcasting authorities in Berlin.

I was informed that the program would consist of ordinary musical items and some news. "If the question might be asked," I said, "who will supply the news?"

"All broadcasting in Germany," he answered, "is in control of Dr Goebels, our Minister of Propaganda. But please remember that propaganda in German does not mean quite the same as in English. With us it means more information."




**December 1959**

**Xerox copier:** A prototype electrostatic printer makes inexpensive finished pictures in seconds from photographic negatives. The machine has been developed by Haloid Xerox Inc, for the US Air Force.

The device produces finished, positive, continuous-tone pictures on white unsensitised paper at the rate of 20ft/min, making a 9 x 9 inch print every 2¼ sec.

Under combined sponsorship of the US Air Force and Signal Corps, the machine was contracted for and technically monitored by the Aerial Reconnaissance laboratory.

The machine operates on the principles of xerography, making continuous-tone pictures in a machine in daylight and without chemicals or sensitised paper.

In one continuous cycle, the unit exposes, prints and finishes dry, positive pictures from a 500ft roll of negative film up to 9in wide.

With a simple adjustment, positive pictures can be made from positive film equally well.

**Rocket test:** Escape equipment was successfully tested recently for the US satellite capsule that will carry man into space.

Engineers of the National Aeronautics and Space Administration (NASA) launched the capsule to an altitude of 38,000ft with a powerful "Little Joe" booster.

The capsule is similar to that in which a Mercury astronaut will be fired into orbit some time in 1961.

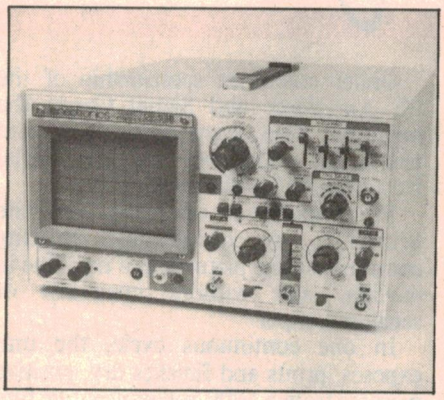
If anything goes wrong at launching time the escape rocket can be triggered to lift the capsule free of the booster.

**Serviceman meets solid state:** Remember how, about three years ago, most of us were having a mild attack of the horrors at the thought of having to service TV sets? Well, with that one behind us, most servicemen are now facing up to another newcomer; transistor sets. While in no sense as big a problem as TV, there are plenty of important things to learn about this phase of the art.

Thus, for the second time in a few years, the serviceman has had something fundamentally new and different thrust upon him and has had to acquire new knowledge and new experience in order to cope with it.

Happily enough, TV seems to have arrived and settled in without causing too many mental breakdowns, and most of us, looking back, probably wonder what we worried quite so hard about.

Looking forward, I can think of plenty to worry about. I wonder how long it will be before we are faced with the ultra miniature, all transistor, colour TV set? Ouch!



## Dual trace oscilloscopes

Neotronics Pty Ltd has recently released two new oscilloscopes, a 20MHz model designated OS-620, and a 35MHz model designated OS-635. Both are dual trace CROs which have many features suited to the hobbyist. The OS-635 has a delayed trigger facility which is not available on the cheaper OS-620. The OS-620 model, however, features a component test function which is not available on the other CRO.

The oscilloscopes come securely packed in a cardboard box, and each includes a pair of probes, spare fuses, and an instruction manual. Both CROs measure 295 x 165 x 355mm(WxDxH) and their layout and styling are similar. Both have a 150mm internal graticule, post deflection acceleration CRT, with blue-green phosphor.

The graticule itself has 10 x 8 divisions, each measuring 10 x 10mm, and includes markings indicating 0, 10, 90 and 100%. The internal graticule has the advantage of eliminating parallax errors when taking readings from the display.

Vertical sensitivity is controlled by the usual 5-2-1 stepped attenuators with a concentric variable attenuator. The maximum sensitivity is 5mV per division for both oscilloscopes, the 635 having a x5 magnification facility extending this range to 1mV per division. Minimum sensitivity is 10V per division on the 635 and 20V per division on the 620.

Sweep range is similarly variable by means of a rotary control providing 5-2-1 steps from a minimum of 0.5 seconds per division. Maximum sweep speed is 0.2$\mu$s on the 620 and 0.1$\mu$s on the 635. Both CROs have a x5 magnification facility on the horizontal axis.

The main feature of the 635 over the 620, apart from its higher bandwidth, is its delayed trigger facility. This feature can be used to examine in detail a portion of the incoming waveform which occurs some time after the trigger point. The 635 oscilloscope allows delays of between 1$\mu$s and 100ms to be selected.

The component test function on the 620 is designed to trace out the voltage-current characteristic of the component or network connected across the banana sockets provided. This feature although interesting, is of little practical use.

The instruction manuals supplied with the CROs are well written and cover all of the aspects of the operation of the instruments. As well as this, the manuals include measuring hints and a description of circuit operation. Full circuit diagrams and component overlays are included, as are test and calibration procedures.

To sum up, these CROs have most of the features that a hobbyist could want at a reasonable price. The OS-620 sells for $574.20, while the OS-635 is priced at $806.20 so these oscilloscopes represent good value for money. For further information contact Neotronics Pty Ltd, 37 Ryledale Rd, West Ryde, or phone them on (02) 807 4739.

## Weller soldering stations

The Cooper Tool Group has announced the availability of three new temperature controlled soldering stations, the WTCPN, the WMCP-EC, and the EC2000D.

The WTCPN is a low voltage, transformer operated soldering station built with continuous on-line work in mind. Tip temperature is controlled by the Weller "Closed loop" method, which protects sensitive components. The grounded tip also protects voltage and current sensitive components.

The Weller PT series of tips for the WTCPN provide tip temperatures of 315°C, 370°C, and 430°C. By quickly changing the tip, temperatures can be varied.

Other features include a non-burnable cord, lightweight pencil grip iron, impact resistant case, on/off indicator light, tip tray, and a large sponge for keeping tips clean on the job.



The WMCP-EC is a miniature temperature controlled 15W soldering iron system. It comes complete with a selection of eight miniature soldering tips, ranging from 0.4mm to 3mm with conical, both straight and bent, and spade forms. The system is ideally suited to micro-circuit technicians, watchmakers, and others involved in fine work.

Temperature control is via a sensor which transmits the actual tip temperature to an evaluator, and the heat lost by radiation, heating the workpiece, and melting the solder is replenished by the 15W element. The working temperature is continuously variable between 40°C and 450°C with the set temperature automatically maintained with 2°C.

The EC2000D is, technologically, the most advanced unit marketed by the company. Tip temperatures range from 175°C to 450°C and may be selected and locked at any desired temperature by the operator. Actual tip operating temperature is displayed on a three digit LED digital display to within 1°C, and the tip temperature is maintained at the desired setting.

The EC2000D is ideal for delicate and precision soldering applications and where continuous use is necessary. Soldering pencils are interchangeable without recalibration of the temperature setting, allowing complete versatility in use. A selection of nine iron plated Weller ET series tips in sizes from 0.8mm diameter to 5.0mm diameter is available.

For further information contact the Albury Sales Office of The Cooper Tool Group Limited at PO Box 366, Albury, NSW 2640. Telephone (060) 21 5511.

## Variable auto-transformers

Electromark has introduced a new series of variable auto-transformers suitable for any equipment controlled by voltage variation. The SD range covers power ratings from 500VA to 200kVA, and motor driven models are available for remote control operation.



The M-types, ranging from 500VA to 10kVA, have been manufactured in Japan to Electromark specifications for Australian use. Models up to 15A incorporate Australian standard output sockets and are fitted with input cords and plugs. A voltmeter is fitted as standard equipment and the larger models have a circuit breaker in place of a fuse.

All are single phase units, designed for 240V input and 0 to 260V output. They will operate on either 50 or 60Hz, have an efficiency of better than 90% and a power factor better than 95%. They are convection cooled, have an insulation resistance of more than 3MΩ at 500V DC, and are tested at 1500V AC for one minute.

Further information from Electromark Pty Ltd, PO Box 184 Mortdale, NSW 2223. Phone (02) 570 7287.

## Security devices from Dick Smith

Dick Smith Electronics announces the availability of two new, moderate cost security devices. One of these, called the "Lockalarm", is a home security device for attachment to doors; the other called an Alarm/Torch, is a personal security device.

The Lockalarm is based on the standard chain lock for doors, but carries the idea two steps further. First, the chrome plated solid steel chain doesn't just latch on; it is attached to a lock that can only be unlocked by a special key. The unit can be set and unlocked from either the inside or outside.

Second, the unit incorporates an alarm, which is set to go off the instant anyone attempts to open the door against the chain (without first unlocking and releasing it).

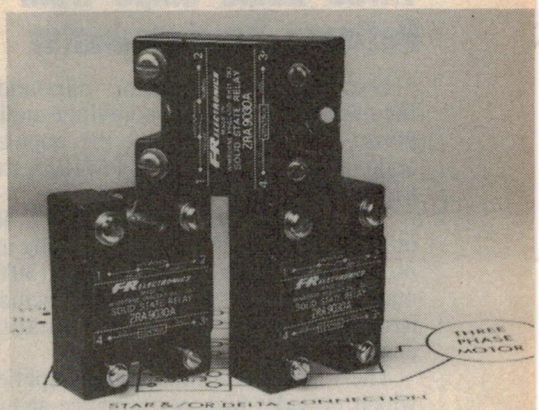
The key-operated chain lock and burglar alarm is easy to fit and can be installed in a matter of minutes. No special tools are needed and there are no wires to connect. A screwdriver is all that is needed to secure it to virtually any door. An ordinary 9V battery powers the alarm.

The Alarm/Torch looks like a sleek, pocket or purse-sized torch. In fact, if the standard torch slide switch is pushed forward, it acts as a normal torch. But, should the need arise, sliding the switch back will activate an ear-splitting alarm to frighten off the would-be attacker.

Ideal for use after dark, on public transport or in any increased personal security situation, the Alarm/Torch can also be used as a temporary door or window alarm by means of a door/window contact included in purchase price.

Both the Lockalarm and the Alarm/Torch are available from Dick Smith Stores throughout Australia.




## Industrial switches and relays

C&K Electronics (Aust.) Pty Ltd, announce the availability of two new industrial switching devices from the English firm FR Electronics. One is a three phase solid state relay and the other a float switch for liquid control.

The three phase solid state relay is FR Electronics' ZRA 9000. These units are capable of switching up to 480 volts AC making them ideal for use with three phase motors and other three phase loads. They are available in either DC or AC input control voltage versions, and have a standard blocking voltage of 800 volts (900 volt versions can be supplied as an option). Another available option is a voltage clipper, if transients above 800 volts are expected.

Standard current ratings are either 30A or 45A, and surge capability is 250A and 375A respectively, for 10ms.

The float switch is the RSF33. It is manufactured in Maranyl, an ICI plastic, suitable for use in non-corrosive fluids down to 0.785 specific gravity.

The unit is simple to use and employs a reed switch, giving very high reliability combined with a switching capacity of up to 100VA at mains voltage. The unit can be used to indicate low level, or, simply by rotating through 180°, to indicate high level.

All units can be tested from ordinary commercial standards up to the highest military standard (05/21) and CAA approval. Existing applications for this device include fuel level control, fluid level control in washing equipment, and flood control warning.

Further information from C&K Electronics (Aust.) Pty Ltd, 15 Cowper St, Parramatta, NSW, 2150. Phone (02) 635 0799.

## Three audio chips from National Semiconductor

National Semiconductor announce the release of three new monolithic audio power amplifiers aimed at the popular audio market. They are the LM1875, the LM831, and the LM2879.

The LM1875 delivers 20W into a 4Ω or 8Ω load on ±22V supplies. Using an 8Ω load and ±30V supplies, over 30W may be delivered. Other features include low distortion and high quality performance.

The LM831 is a dual power amplifier which provides high performance at the very low voltages needed for portable entertainment devices, such as personal headphone stereo sets. Using two independent amplifiers, the LM831 gives stereo or high power bridge (BTL) operation from two or three cell power supplies.

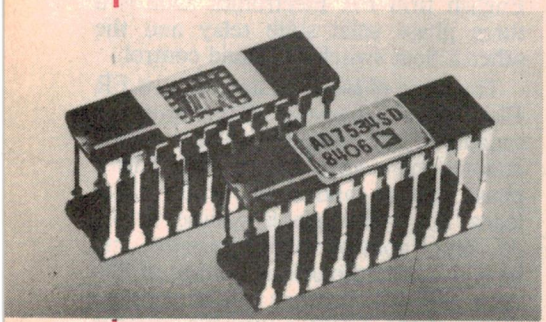
Featuring high power (400mW, 8Ω, BTL, three volts), low noise and low THD (total harmonic distortion), the LM831 is used in portable tape recorders, portable radios, headphone stereo sets, and portable speakers.

The LM2879 is a monolithic dual power amplifier that offers high quality performance for stereo phonographs, tape players, recorders and AM-FM stereo receivers.

This new chip delivers 9W/channel (typical) to an 8Ω load. The amplifier contains an internal bias regulator to bias each amplifier.

Device overload protection consists of both internal current limit and thermal shutdown. The LM2879 is designed to operate with a minimum of external components. It provides 70dB ripple rejection and channel separation.

Further information from National Semiconductor (Aust) Pty Ltd, 23 Cleg St, Artarmon, NSW, 2064.




## Latest releases from Analog Devices

Parameters Pty Ltd, Australian agents for Analog Devices of Massachusetts, USA, advise the release of three new devices by this company. One is the AD595, a monolithic thermocouple amplifier with on-chip cold junction compensation.

The AD595's on-chip temperature measuring circuit, instrumentation amplifier and open thermocouple alarm circuit delivers a single-chip solution to many temperature measurement and control applications. The ability to connect a thermocouple to the AD595 and measure temperatures to within ±1°C reduces costly board space, trimming and assembly requirements associated with competing discrete and modular designs.

The second device is the AD7560, a monolithic DC/DC converter which accepts a single +5V input and generates −5V, −10V, −15V, +10V and +15V output voltages. With this capability, the AD7560 can power components such as op amps, analog-to-digital converters and digital-to-analog converters which require plus and minus power supplies.

For system designs with only a +5V supply, the AD7560 offers a single-chip solution to generating additional supply voltages.

The third device is the AD7534, a monolithic 14-bit digital-to-analog converter (DAC) which guarantees monotonicity and the industry's highest accuracy over temperature. The high accuracy over temperature results from a new design technique developed by Analog Devices, Inc. (patent pending) which reduces leakage current versus temperature to only one-tenth that of competing devices. Leakage current appears in the output as gain, offset, and differential linearity errors.

As a replacement for 12-bit CMOS DACs, the AD7534 eliminates the need for trim potentiometers and their associated labour costs at an incremental cost ranging from $2 to $4. Specified for operation with a single +12V to +15V power supply, the AD7534 dissipates maximum power of 36mW, provides TTL and 5V CMOS logic compatibility, and full four-quadrant multiplication.

Further information from Parameters Pty Ltd, 41 Herbert St, Artarmon NSW 2064.

## PA speakers, sirens from Benelec

Sydney-based distributor, Benelec Pty Ltd, now stocks a comprehensive range of public address and communications speakers with over a dozen types in their range.

Sizes and power ratings range from a compact 88mm diameter model rated at 4W to a 305mm diameter model rated at 50W.

Benelec also stocks a range of sirens and alarms. Operating voltages range from 6V up to 50V, with sound pressure levels of up to 124dB available. The 30-5403 "microsiren", for example, measures only 40 × 55mm, has a nominal current drain of 250mA and a sound pressure level of 116dB at one metre.

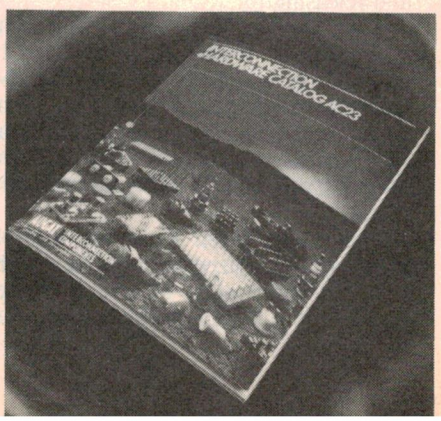
For product details: Benelec, PO Box 21, Bondi Beach, NSW 2026. Phone (02) 665 8211.

## Hardware catalog from T.S.M. Sales

T.S.M. Sales Australia has advised that they are the exclusive distributor in Australia and New Zealand for the Augat group of companies.

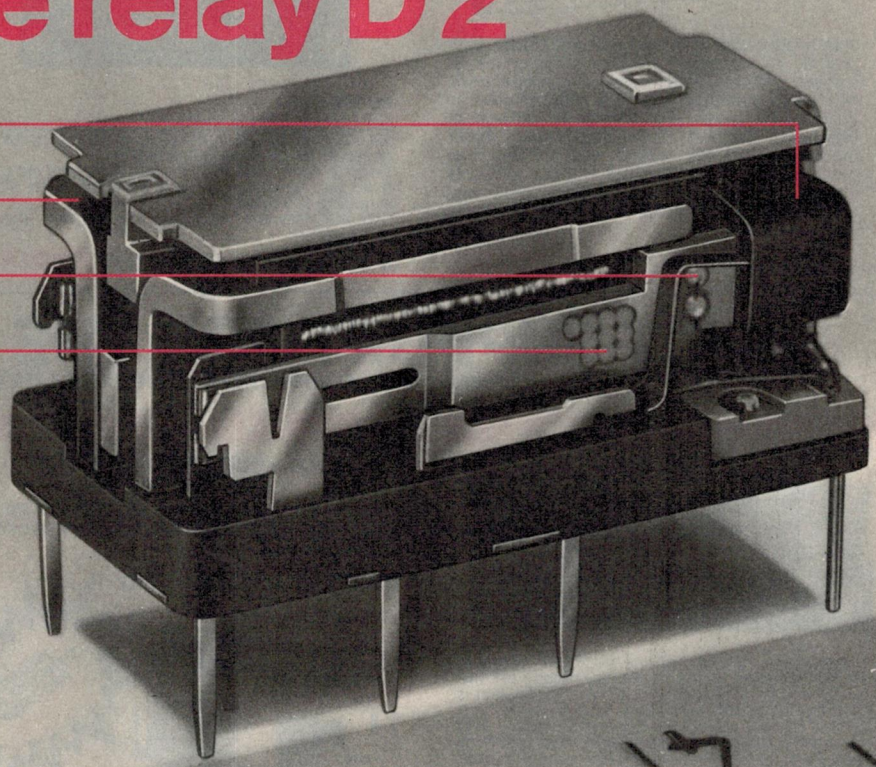
Augat have recently released their new 96-page Electronic Inter-connection Hardware Catalog. Featured in this catalog are a new range of coax adapters for PCBs, programming devices, test jacks, transistor sockets, relay sockets, tools, zero profile solderless and pin terminals. Each product is described and identified together with specifications and engineering drawings.

The catalog is available free on application from T.S.M. Sales Australia, 8/158 South Creek Road, Dee Why West, 2099. Tel (02) 982 5666. Telex AA74758.



SIEMENS

# Contacts you can rely on:
# Miniature relay D 2



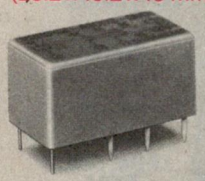
**No operating comb**
prevents wear on the contact blades

**Permanent magnet system**
ensures maximum operate sensitivity

**Laser welding**
offers high reliability

**Laser adjustment**
guarantees precise contact positioning

**actual size**
Miniature relay D2
(20.2 x 10.2 x 10 mm)



The present day relay market insists on miniaturization and highest possible reliability. Siemens, as a relay user, measures up to these demands.

In the miniature relay D 2 we present a product designed to meet precisely the market requirements.

- DIL pin arrangement
- With two changeover contacts
- Contact force approx. 8 cN
- High test voltage
- Getter-protected contact chamber
- No operating comb

New manufacturing techniques such as laser welding and laser-adjustment prolong relay life and improve reliability, offering the user a new dimension in cost-effectiveness.

The miniature relay D 2 can be used in a variety of applications such as measuring circuits, control-, regulating- and process systems, entertainment industry, telecommunications, signal systems and medical equipment.

Siemens Ltd. (Incorporated in Victoria)
544 Church Street, Richmond, Vic. 3121
Melbourne: 420 7111 Sydney: 436 8711
Brisbane: 369 9666 Perth 362 0123

667/1170

## Electromechanical components from Siemens

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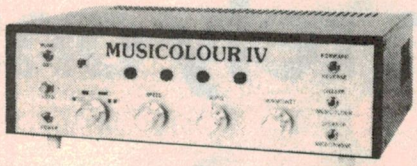


**Dear Customer,** At Altronics we are continually trying out methods of improving our range of quality products and the high standard of service we offer our Shop, Mail and Phone order customers. I believe our future prosperity will be a direct reflection of the standards of service we have adopted. So for November and December 84 we pledge that if you find our products and/or service is not as we claim you may return your purchase to us for a **full refund plus $5.00** for your inconvenience (mail/phone order customers please allow transportation costs)

Regards

*Jack O'Donnell*

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Combination Colour Organ and Light Chaser. Four channel colour organ. Internal micro-phone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800 ..... **$89.50**

## MICROWAVE OVEN LEAK DETECTOR

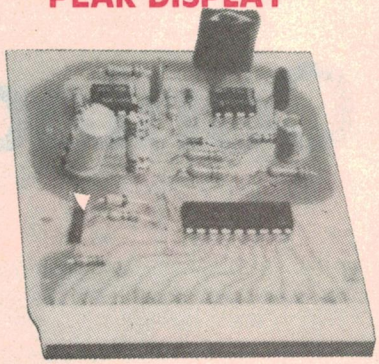



**ETI PROJECT**

Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter.
Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter.
Genuine Hewlett Packard Hot Carrier Diode supplied.

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## LED BARGRAPH PEAK DISPLAY



This easy to build level meter uses our exclusively imported LED bargraph module which gives it a very professional finish indeed. Indicates from —21dB to + 6dB using a logarithmic scale. **Great Value!**

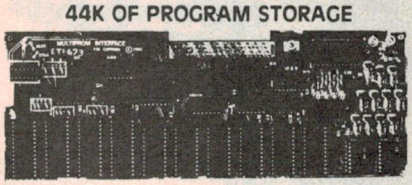
K 5412..... **$16.50**

# ★ KIT SUPPORT FOR THE MICROBEE ★

**MICROBEE IS A REGISTERED TRADEMARK OF APPLIED TECHNOLOGY PTY LTD**

## MULTIPROM INTERFACE

**44K OF PROGRAM STORAGE**



A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

**THE MICROBEE® KIT OF 1984**

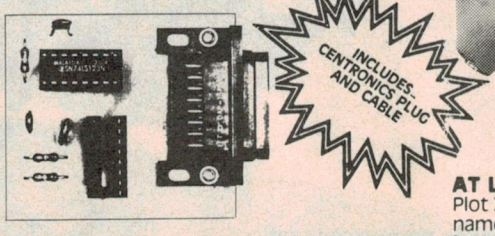
K9673..... **$99.50**

## PARALLEL INTERFACE

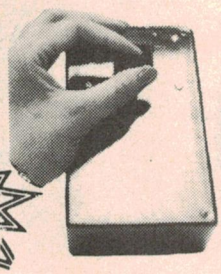
**BUILD YOUR OWN INTERFACE AND SAVE $$$**

A simple kit to build — takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer.

K9671..... **$29.95**




## PROPORTIONAL JOYSTICK



**SELF CENTERING**

K9674

**$32.50**

(ETI DEC '83)

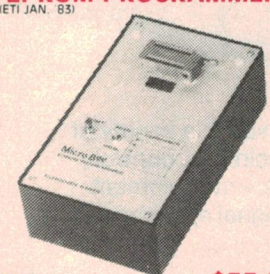
**FOR THE BEE!**

**AT LAST AN ANALOGUE JOYSTICK**

Plot X-Y co-ordinates on the screen, sign your name. A great graphics aid. Complete kit **including case,** software example.

## EPROM PROGRAMMER

(ETI JAN. '83)



K9668..... **$55.00**

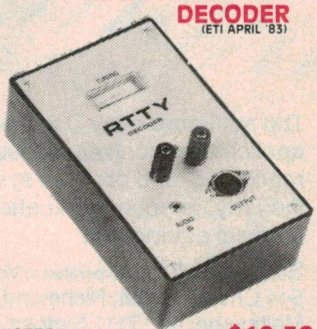
**Versatile, low cost and easy to build.** Plugs straight into the microbee I/O port. Suitable for 2716, 2732, 2532, 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time.

**KIT FEATURES** Sockets for all other IC's 1 x 2716 supplied — get started straight away Front Panel and Mains (SEC approved) transformer 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included) DB 15 Plug Complete to last nut and bolt.

(See Review ETI AUGUST 1983)

## RADIOTELETYPE DECODER

(ETI APRIL '83)




K9733..... **$19.50**

Display RTTY encoded messages on your Video Monitor. Receive up to date weather information, International News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques Single PCB Construction Kit includes DB15 Plug and backshell for connection to microbee Shielded pretinned PCB.

## NEW MICROBEE LIGHT PEN

(ETI AUGUST '83)



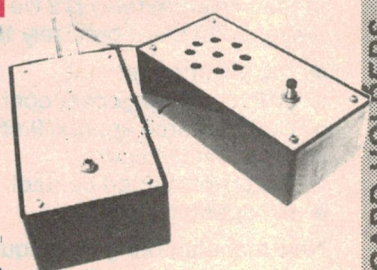

**PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!**

K9649..... **$19.95**

AT LAST — a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the I/O port. ★ Complete kit including DB15 2m CORD ★ Fully documented with software example.

## FAX-DECODER

(ETI SEPT. '83)



K 9763..... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc and then reproduce them on your dot-matrix printer.

★ Complete kit of parts includes DB15, Ribbon Cable

★ SOFTWARE LISTING

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## 7 DIGIT FREQUENCY COUNTER




**UNBELIEVABLE 0.005% ACCURACY**

☆ **Frequency and Period measurement to 500 MHz (with optional prescaler)** ☆ **High input sensitivity. Professional unit at a fraction of the cost of built up units.**
☆ IC sockets provided throughout ☆ Low age rate 10.000 MHz XTAL ☆ Quality ABS plastic case with deluxe Front panel ☆ Specified LSI.

K2500..... **$119.50**

**PRESCALER**
K2501..... **$26.00**

**DECIMAL POINT**
K2502..... **$7.50**




## VIDEO AMPLIFIER

Brilliant new kit from EA, **Super cheap** and **Super Effective.** Whilst our K5830 is suitable primarily for VCR use this video amplifier is best suited to use with computers. The EA documentation supplied is extremely well written and provides details for installation into television sets.

**NO MORE SMEARY COLOURS, SIGNAL BEATS OR RF INTERFERENCE**

K5850..... **$14.95**




## VIDEO ENHANCER

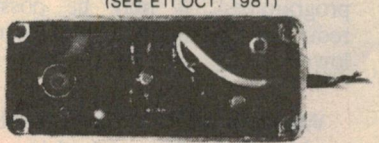
Here's a **simple** but **effective** Video Enhancer that is super **easy to build** at a fraction of the cost of commercial models.
Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal.

AT LAST A VIDEO ENHANCER KIT

K5825..... **$35.00**

## VIDEO RF MODULATOR

(SEE ETI OCT. 1981)



If you cannot afford a Video Monitor for your computer this is the kit for you. Super stable oscillator design and very low modulation distortion ★ Works with both B & W and Colour TV sets ★ Suitable for computers, TV games, TV pattern generators or what have you. Deluxe kit featuring heavy duty diecast box for RF shielding ★ Input and output sockets.

K9760 **$17.50**

## FUNCTION GENERATOR



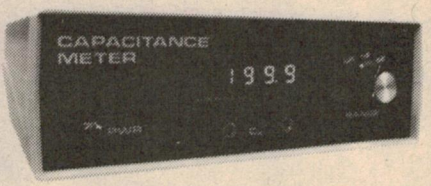

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K2505..... **$85.00**

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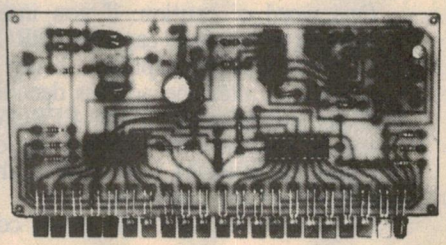
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Each kit includes precision measured capacitors for accurate calibration of each range.

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### TWIN RANGE LED TACHO

(SEE ETI AUGUST 1980)



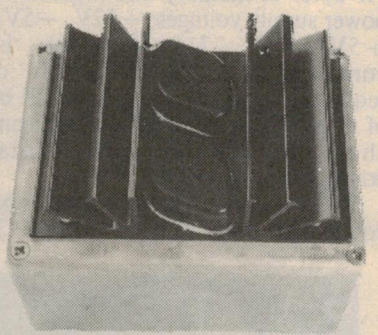
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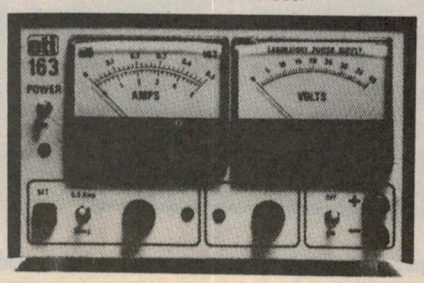


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|---|---|
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| | 0-5 A. variable limiting |
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| | <100 mV up to 5 A |
| **Maximum output power** | 200 watts |
| **Metering** Voltage | 0-40 V in 1 V divisions |
| Current | 0-0.5 A in 20 mA divisions |
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Series regulator design enables design and development of sensitive high gain audio and RF circuitry free from hum and noise sometimes associated with other techniques.

K3325..... **$175.00**

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# A Versatile EPROM

*This EPROM Copier is easy to build and will cost less than $70. It can program 2716 and 2732 EPROMs and copy 2708, 2716 and 2732 devices.*

There are many situations where one needs to copy the contents of one EPROM into another. For example, if you want to manufacture a small number of microprocessor-based products which use EPROMs, the copier can provide duplicates of a prototype master EPROM. Similarly, the copier is very handy for supplying preprogrammed EPROMs to customers at the point of sale. A master EPROM, such as our Car Computer EPROM from August 1982, can be kept by the supplier and copies provided on a "while you wait" basis.

As EPROM technology improves, it can also be advantageous to upgrade your EPROM storage to more modern devices. The classic 2708 EPROM holds 1K bytes of memory and requires three power supply voltages: +12V, −5V and +5V. The 2716, however, is a contemporary device which only requires a +5V supply. It holds 2K bytes of memory and is actually less expensive than its smaller and outdated counterpart, the 2708.

Much of the microprocessor-based equipment prior to 1979 utilised 2708 technology. With this copier, you can now reprogram into 2716 EPROMs or, alternatively, into the 4K byte 2732. This will enable you to do away with complex power supplies and, as an added bonus, you can upgrade your EPROM storage capacity.

For example, the contents of two 2708s can be programmed into a single 2716 device; or two 2716 EPROMs can be programmed into a single 2732 EPROM.

One word of caution: if you intend upgrading into a larger capacity EPROM for use in existing equipment, it may be necessary to alter the address decoding and pin connections to the EPROMs. Some equipment provides link options for various EPROM types and is thus readily suited for upgrading.

Of course, you can also direct copy between two 2716 or two 2732 EPROMs. Programming time for the 2716 is 80 seconds minimum while the 2732 takes twice this time. Note that Texas Instruments sells equivalent devices to the 2716 and 2732, and these are designated as the 2516 and 2532 respectively.

## Main features

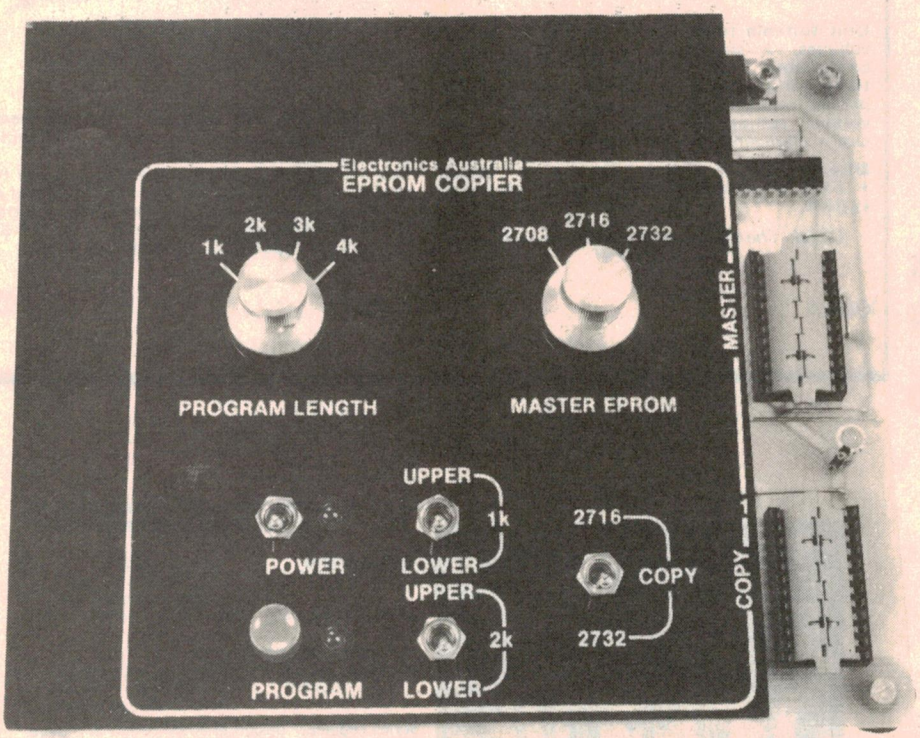
The EPROM Copier is a free-standing unit consisting of a single printed circuit board and a perspex front panel. This panel is supported by PCB-mounted switches while the PCB itself is supported on six rubber feet. The right hand side of the PCB is left uncovered to expose two zero insertion force sockets for the master and copy EPROMs. A 12VAC plugpack powers the unit.

The front panel controls are straightforward. A rotary switch at top right selects one of the three EPROM types for the master EPROM socket while the Copy toggle switch selects either a 2716 or 2732 copy EPROM. The momentary contact Program switch (bottom left) initiates programming and lights the programming LED.

The programming LED automatically extinguishes when programming is complete.

A further feature of the EPROM Copier is the Program Length control. This selects the address at which programming ceases and is selectable in 1K increments. Normally, this control is set to the memory capacity of the master EPROM.

If the master EPROM is not fully programmed, it may be possible to reduce programming time by using a lower setting on the Program Length




**Above is a view of the prototype. The front panel is mounted directly on the switches while the PCB is supported by six rubber feet.**

We estimate that the current cost of parts for this project is

**$65-70**

This includes sales tax but not the plugpack transformer.

# COPIER

COPIER

by JOHN CLARKE

control. The only proviso here is that the lower setting must encompass all the programmed locations in the master EPROM.

Copying between differing EPROMs requires a further control feature. This involves selecting the particular memory block of the copy EPROM. For example, when copying from a 2708 into a 2716, you can select whether the 2708 program goes into the upper or lower 1K block of the 2716. Similarly, when copying from a 2708 to a 2732, any one of the four 1K blocks can be selected.

The final possibility involves copying from a 2716 into a 2732. In this case you can select between either the upper or lower 2K memory block.

## How it works

The basic concept behind the EPROM Copier is relatively straightforward: both EPROMs are connected in parallel so that the address and data lines are common. A binary counter also connects to the address lines and sequentially counts through all the EPROM addresses, starting from the zero address.

The master EPROM is connected in the read mode so that its data lines are outputs, while the copy EPROM is connected in the program mode so that the data lines are inputs. At each address, the data from the master EPROM is read by the copy EPROM during programming. Programming stops at the end of the master EPROM address range, as selected by the Program Length switch (S5).

Programming 2716 and 2732 EPROMs involves applying a TTL level 50ms pulse to the programming (PRGM) pin at each memory location. The 2716 requires a high TTL pulse while the 2732 requires a low going pulse to the PRGM pin. In addition, a 25V DC level must be present on the Vpp pin during the programming sequence.

Fig. 1 shows the pin connections and mode selections for each of the three EPROM types. Note that the connections are directly compatible with the exception of pins 18 to 21. These latter are the power supply and mode select pins for each EPROM.

## The circuit

As previously mentioned, the address lines from A0 to A9 and the Data lines from D0 to D7 are connected in parallel between the master and copy EPROM sockets. IC1 is a binary counter used for the address counting and drives the address lines of the EPROMs. The remaining connections from pins 18 to 21 are connected to obtain the correct

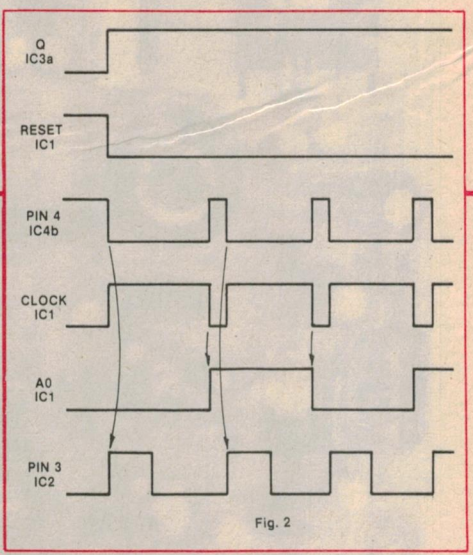
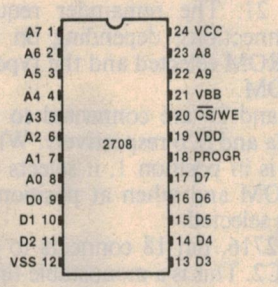


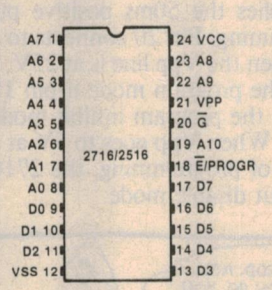

Fig. 2

**Fig. 1 (below) shows the EPROM data while Fig. 2 is the waveform timing digram.**

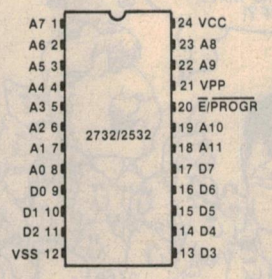



| MODE | PIN NUMBER | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9-11, 13-17 | 12 | 18 | 19 | 20 | 21 | 24 |
| * READ | D OUT | VSS | VSS | VDD | VIL | VBB | VCC |
| PROGRAM | D IN | VSS | PULSED VIHP | VDD | VIHW | VBB | VCC |
| DESELECT | HIGH Z | VSS | GND | VDD | VIH | VBB | VCC |

VBB = −5V VCC = +5V
VDD = +12V VPPH = +25V
VSS = GND




| MODE | PIN NUMBER | | | | | |
|---|---|---|---|---|---|---|
| | 9-11, 13-17 | 12 | 18 | 20 | 21 | 24 |
| *READ | DATA OUT | VSS | VIL | VIL | VCC | VCC |
| * OUTPUT DISABLE | HIGH Z | VSS | DONT CARE | VIH | VCC | VCC |
| STANDBY | HIGH Z | VSS | VIH | DONT CARE | VCC | VCC |
| * PROGRAM | DATA IN | VSS | PULSED VIL TO VIH | VIH | VPPH | VCC |
| PROGRAM VERIFY | DATA OUT | VSS | VIL | VIL | VPPH | VCC |
| *PROGRAM INHIBIT | HIGH Z | VSS | VIL | VIH | VPPH | VCC |

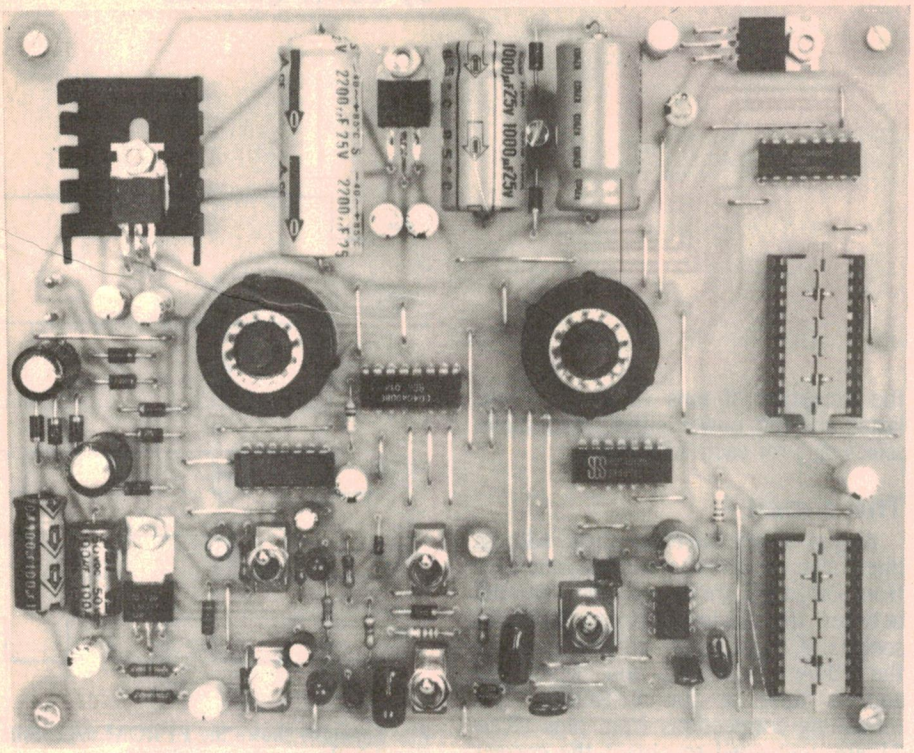



| MODE | PIN NUMBER | | | | |
|---|---|---|---|---|---|
| | 9-11, 13-17 | 12 | 20 | 21 | 24 |
| * READ | DATA OUT | VSS | VIL | 5V | VCC |
| OUTPUT DISABLE | HIGH Z | VSS | VIH | 5 TO 25V | VCC |
| * STANDBY | HIGH Z | VSS | VIH | 5V | VCC |
| * PROGRAM | DATA IN | VSS | PULSED VIH TO VIL | VPPH | VCC |
| PROGRAM VERIFY | DATA OUT | VSS | VIL | 5V | VCC |
| *PROGRAM INHIBIT | HIGH Z | VSS | VIH | VPPH | VCC |

Fig. 1

* MODES USED IN EPROM COPIER

# Eprom Copier



**This view shows the PCB assembly before the front panel is fitted.**

mode of operation as described in Fig. 1.

Connections to the master EPROM are straightforward since it is always wired in the read mode. According to Fig. 1, pin 20 can be permanently tied to ground while, for the 2732, pin 18 can be tied to the A11 address line from IC1.

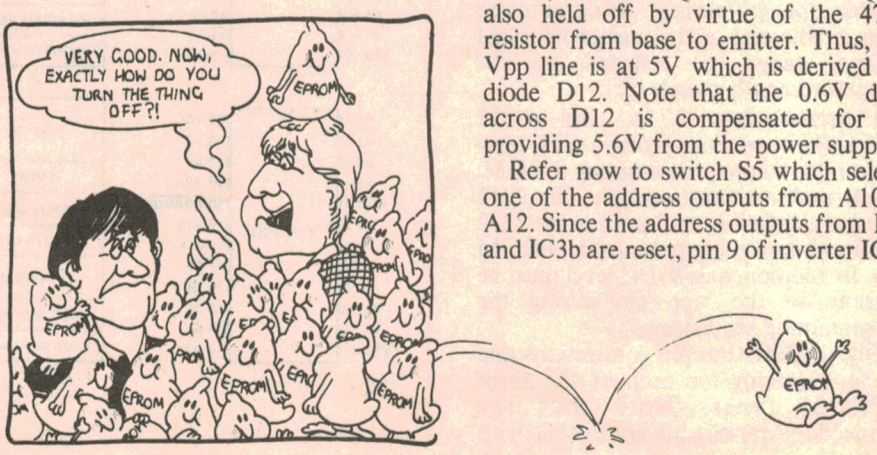
For the 2716 and 2708, pin 18 should be at Vss for the read mode. As it happens, A11 is at Vss for all memory locations up to 2K, which is within the address range of both EPROMs. Consequently, pin 18 can also be permanently tied to A11 for these devices. Should copying be allowed beyond the 2K limit, the high A11 will not damage either EPROM.

Switch S1 is a 4-pole 3-way rotary switch and selects for a 2708 in position 1, a 2716 in position 2 and a 2732 in position 3. The S1c and S1d poles are used for the master EPROM. S1c connects pin 19 to +12V for the 2708 and to the A10 address line for the remaining EPROMs. Pin 21 is connected to −5V via S1d for the 2708 position and to +5V for the 2716 and 2732 EPROMs. These connections satisfy the read mode requirements for all three EPROMs.

The copy EPROM requires more switching than the master EPROM to enable both the programming and output disable/standby modes. The only common pin between the 2716 and 2732 EPROMs in this application is the Vpp input, pin 21. The remainder require various connections, depending on the master EPROM selected and the type of copy EPROM.

Pins 18 and 20 are connected to the wiper of S2a and S2b respectively. When the switch is in position 1, it selects the 2716 EPROM and when at position 2, the 2732 is selected.

For the 2716, pin 18 connects to the output of IC2. This is a monostable timer which supplies the 50ms positive pulse for programming. Pin 20 connects to the 5V rail. When the Vpp line is at 25V, the 2716 is in the program mode if pin 18 is high and in the program inhibit mode if pin 18 low. When Vpp goes to 5V at the completion of programming, the 2716 is in the output disable mode.




When S2 selects the 2732 EPROM, pin 20 is connected to IC5d. This inverts the programming pulse from IC2 to provide a ground going 50ms pulse. Once again, Vpp is at 25V during programming. The 2732 is in the program mode when pin 20 is low and the program inhibit mode when pin 20 is high. With Vpp at 5V, the 2732 is in standby.

S2a connects pin 18 to the wiper of S1b for the 2732 EPROM. When S1 selects a 2708 or 2616 master EPROM, the A11 address line (pin 18) of the copy 2732 is connected to the wiper of switch S4. This selects the lower 2K of memory of the 2732 when switched low and the upper 2K when high. For a 2732 master EPROM, pin 18 connects to the A11 address output of IC1.

Pin 19 is the A10 address line for both 2716 and 2732 EPROMs. It is connected to the wiper of switch S2 (via S1a) when the master EPROM is a 2708. This allows selection of the upper 1K when the switch is in position 2 and the lower 1K when in position 1. When S1a selects a 2716 or 2732 master EPROM, the A10 address line is connected directly to the A10 output of IC1.

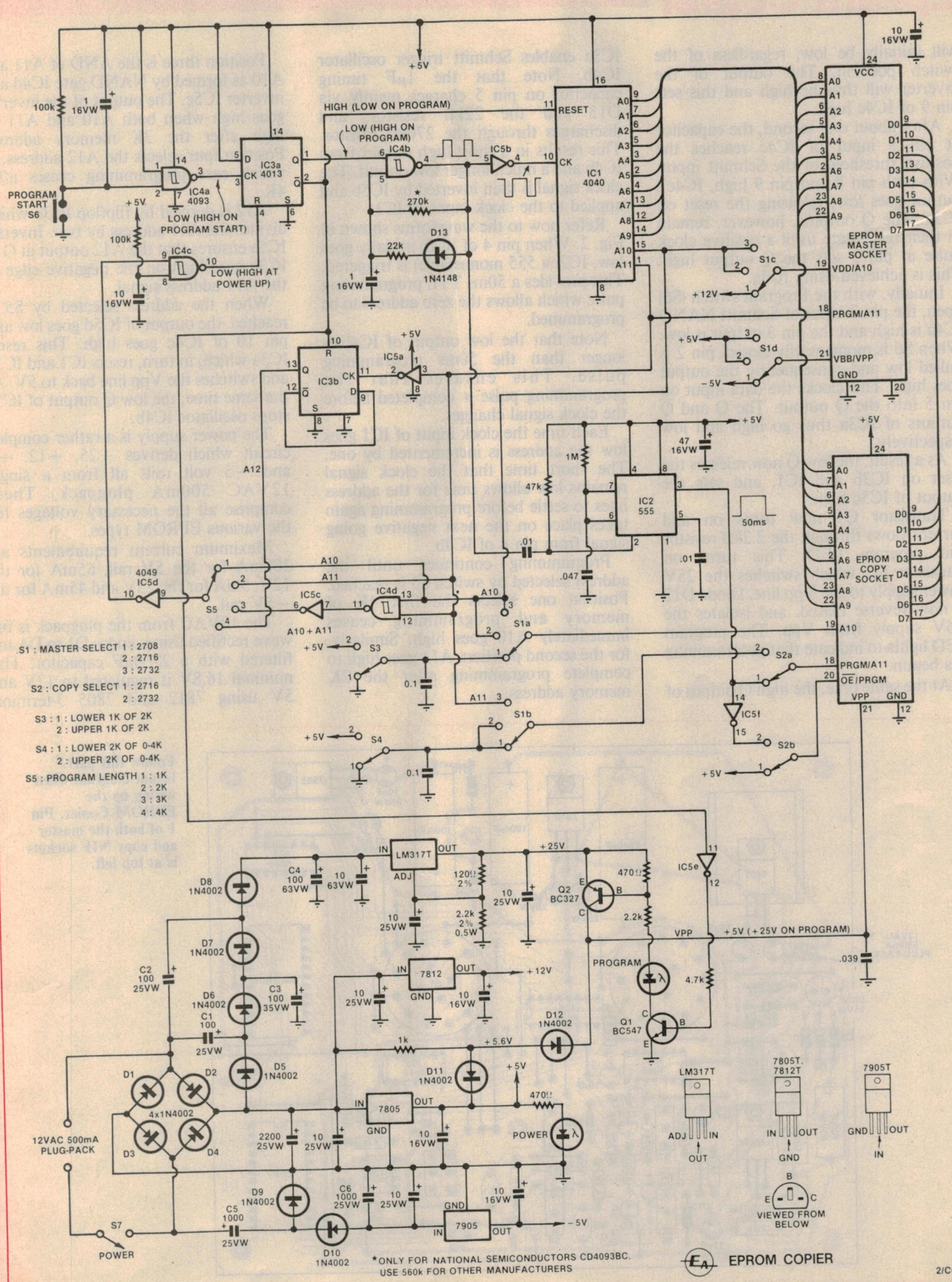
That describes the circuitry around the EPROM sockets. We shall describe the sequence of events that occurs when power is applied.

Initially, when power is first applied, the capacitor at the pin 8 input of Schmitt NAND gate IC4c is discharged. The output, pin 10, is high and this resets IC3a, a D flipflop, so that its Q output is low and the $\overline{Q}$ output is high.

The high signal on $\overline{Q}$ performs three functions. First, it resets IC3b, also a D flipflop, so that its Q output is set low; second, it resets IC1 to bring the address outputs low; and third, it is applied to the input of inverter IC5c.

IC5c is used to control the Vpp line which provides either 5V or the 25V programming level. When IC5c's output is low, transistor Q1 is off and so Q2 is also held off by virtue of the 470Ω resistor from base to emitter. Thus, the Vpp line is at 5V which is derived via diode D12. Note that the 0.6V drop across D12 is compensated for by providing 5.6V from the power supply.

Refer now to switch S5 which selects one of the address outputs from A10 to A12. Since the address outputs from IC1 and IC3b are reset, pin 9 of inverter IC5d


PROGRAM START S6
100k
1 16VW
IC4a 4093
LOW (HIGH ON PROGRAM START)
IC3a CK 4013
HIGH (LOW ON PROGRAM)
LOW (HIGH ON PROGRAM)
IC4b
IC5b
IC1 4040
RESET
CK
270k
22k
D13
1N4148
IC4c
LOW (HIGH AT POWER UP)
10 16VW
+5V
IC3b
IC5a
A12
VCC
EPROM MASTER SOCKET
VDD/A10
PRGM/A11
VBB/VPP
GND
S1c
S1d
+12V
-5V
IC2 555
47k
1M
47 16VW
50ms
.01
.047
EPROM COPY SOCKET
OE/PRGM
VPP
4049 IC5d
S5
A10
A11
A10 + A11
IC5c
IC4d
S1a
S2a
S2b
S3
S4
0.1
IC5f
A11
S1b
S1 : MASTER SELECT 1 : 2708
2 : 2716
3 : 2732
S2 : COPY SELECT 1 : 2716
2 : 2732
S3 : 1 : LOWER 1K OF 2K
2 : UPPER 1K OF 2K
S4 : 1 : LOWER 2K OF 0-4K
2 : UPPER 2K OF 0-4K
S5 : PROGRAM LENGTH 1 : 1K
2 : 2K
3 : 3K
4 : 4K
LM317T
ADJ
IN
OUT
+25V
120Ω 2%
2.2k 2%
0.5W
10 25VW
10 63VW
C4 100 63VW
D8 1N4002
D7 1N4002
D6 1N4002
D5 1N4002
C2 100 25VW
C3 100 35VW
C1 100 25VW
Q2 BC327
470Ω
2.2k
VPP
+5V (+25V ON PROGRAM)
PROGRAM
4.7k
Q1 BC547
.039
7812
+12V
GND
D12 1N4002
1k
+5.6V
D11 1N4002
7805
470Ω
POWER
12VAC 500mA PLUG-PACK
4x1N4002
D1
D2
D3
D4
2200 25VW
10 16VW
D9 1N4002
C6 1000 25VW
C5 1000 25VW
7905
-5V
S7
POWER
D10 1N4002
LM317T
7805T. 7812T
7905T
ADJ
IN
OUT
GND
VIEWED FROM BELOW
B
E
C
*ONLY FOR NATIONAL SEMICONDUCTORS CD4093BC. USE 560k FOR OTHER MANUFACTURERS
EPROM COPIER
2/CC/-

will initially be low, regardless of the switch position. The output of the inverter will thus be high and this sets pin 9 of IC4c high.

After about one second, the capacitor at pin 8 input of IC4c reaches the positive threshold of the Schmitt input. With both pin 8 and pin 9 high, IC4c's output goes low, releasing the reset on IC3a. The Q outputs, however, remain in their reset state until a positive clock pulse at pin 3 sets the Q output high. This is achieved using IC4a.

Initially, with the Program switch (S6) open, the pin 2 input of Schmitt NAND IC4a is high and the pin 3 output is low. When S6 is momentarily closed, pin 2 is pulled low and consequently the output goes high. This clocks the data input on pin 5 into the Q output. The Q and $\overline{Q}$ outputs of IC3a thus go high and low respectively.

As a result, the low $\overline{Q}$ now releases the reset on IC3b and IC1, and sets the output of IC5c high.

Transistor Q1 now turns on and current flows through the 2.2kΩ resistor and program LED. This turns on transistor Q2 which switches the 25V power supply to the Vpp line. Diode D12 is now reverse biased, and isolates the 5.6V supply from Vpp. The program LED lights to indicate that programming has begun.

At the same time, the high Q output of IC3a enables Schmitt trigger oscillator IC4b. Note that the 1μF timing capacitor on pin 5 charges mainly via D13 and the 22kΩ resistor, and discharges through the 270kΩ resistor. This results in a short high output from IC4b and a much longer low output. The clock signal is then inverted by IC5b and applied to the clock input of IC1.

Refer now to the waveforms shown in Fig. 2. When pin 4 of IC4b initially goes low, IC2 (a 555 monostable) is triggered. This provides a 50ms TTL programming pulse which allows the zero address to be programmed.

Note that the low output of IC4b is longer than the 50ms programming pulse. This ensures that the programming pulse is completed before the clock signal changes.

Each time the clock input of IC1 goes low the address is incremented by one. The short time that the clock signal remains low allows time for the address lines to settle before programming again takes place on the next negative going signal from pin 4 of IC4b.

Programming continues until the address selected by switch S5 is reached. Position one selects the first 1K of memory and programming ceases immediately A10 goes high. Similarly, for the second position, A11 goes high to complete programming after the 2K memory address.

Position three is the AND of A11 and A10 as formed by NAND gate IC4d and inverter IC5c. The output of the inverter goes high when both A10 and A11 go high after the 3K memory address. Position four selects the A12 address, in which case programming ceases after 4K.

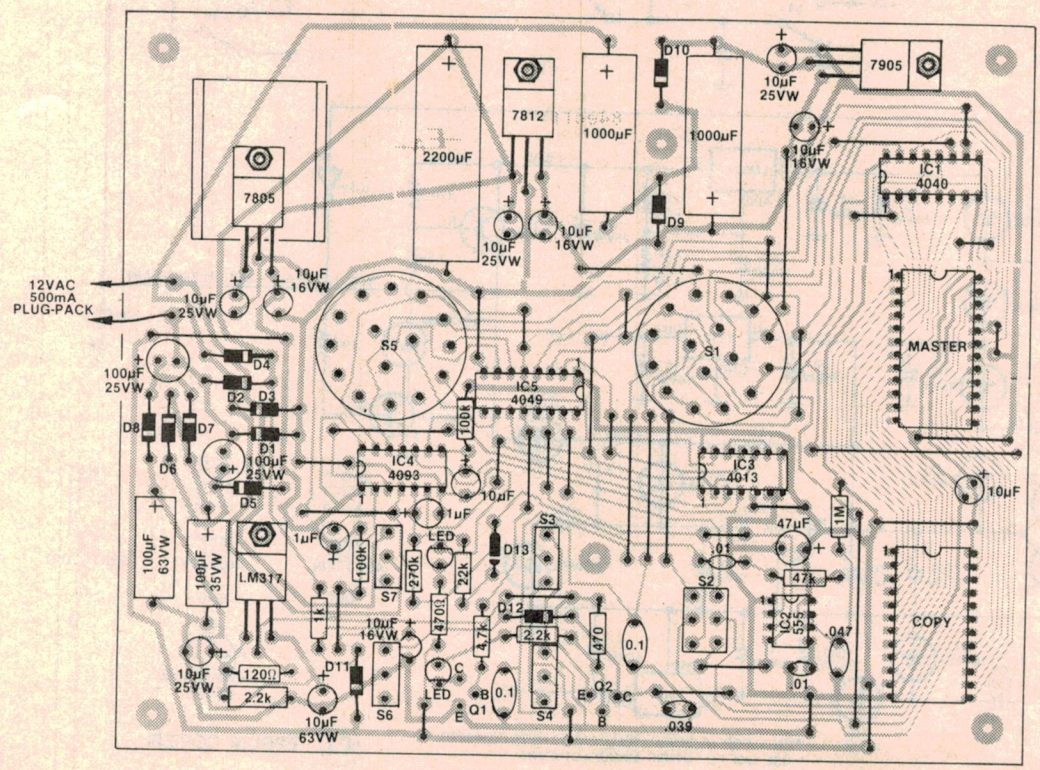
A12 is derived by flipflop IC3b which divides the A11 address by two. Inverter IC5a ensures that the A12 output at Q of IC3b goes high on the negative edge of the A11 address signal.

When the address selected by S5 is reached, the output of IC5d goes low and pin 10 of IC4c goes high. This resets IC3a which, in turn, resets IC1 and IC3b and switches the Vpp line back to 5V. At the same time, the low Q output of IC3a stops oscillator IC4b.

The power supply is a rather complex circuit which derives +25, +12, +5 and −5 volt rails all from a single 12VAC 500mA plugpack. These comprise all the necessary voltages for the various EPROM types.

Maximum current requirements are 300mA for the 5V rail, 65mA for the 12V, 5mA for the 25V and 45mA for the −5V rail.

The 12VAC from the plugpack is full wave rectified using diodes D1 to D4 and filtered with a 2200μF capacitor. This nominal 16.8V is regulated to 12V and 5V using 7812 and 7805 3-terminal




**Follow this parts layout diagram when wiring up the EPROM Copier. Pin 1 of both the master and copy NIF sockets is at top left.**

regulators. Note that D11 and a series 1kΩ resistor are connected across the input and output terminals of the 5V regulator. This provides a 5.6V reference at the anode of the diode.

The power indicator LED is driven from the 5V rail with current limiting provided by a 470Ω resistor.

The −5V rail is derived from a charge pump circuit comprising capacitors C5 and C6 and diodes D9 and D10. When the cathode of D3 goes positive, C5 charges via D9 to the peak of the waveform, or about 17V. On the negative excursion of the AC waveform, D3 conducts and brings the positive side of C5 to ground potential. The negative side of C5 thus goes to −17V and charges C6 via D10.

This voltage is then regulated to −5V using a 7905 3-terminal regulator.

The +25V rail is also derived using a diode charge pump circuit. Capacitors C1, C3 and diodes D5 and D6 function in a similar manner to the negative supply circuit just described. Note that because D5 is referenced to the positive output from the bridge rectifier the voltage across C3 is 34V with respect to ground.

C2 thus charges to +34V via D7 while its negative side is grounded via D1. On the next half cycle of the AC waveform, D1 is reverse biased and the negative side of C2 goes to +17V. The positive side of C2 now goes to +51V and this charges C4 via D8.

Thus, we have about 50V at the input of the LM317 which is set to provide a regulated +25V output.

## Construction

Building the EPROM Copier is a heck of a lot easier than understanding how it works. All the parts are mounted on a single PC board coded 84ec11 and measuring 173 x 142mm. We used a perspex panel with screen-printed lettering for the prototype but most parts retailers will probably prefer to supply an aluminium panel and Scotchcal label.

Begin construction by installing the parts on the PC board, but do not mount the two LEDs at this stage. No special procedure need be followed although it's best to install the low profile components first. Make sure that all polarised parts are correctly oriented and note that diode D13 is a 1N4148 or 1N914 type. The remaining diodes are all 1N4002 types.

The 3-terminal regulators are bolted directly onto the PCB with their leads bent at right angles for soldering. Note that a heatsink is required for the 7805. We used a Thermalloy 6030 type

### PARTS LIST

1 PCB, 173mm x 142mm, code 84ec11
1 Scotchcal label, 143mm x 142mm (see text)
1 perspex or aluminium panel, 143mm x 142mm (see text)
1 12VAC 500mA plugpack transformer
3 SPDT toggle switches (C&K 7101c)
1 snap action momentary contact pushbutton switch (C&K 8121c)
1 DPDT toggle switch (C&K 7201c)
1 4-pole 3-position rotary switch
1 3-pole 4-position rotary switch
2 knobs
2 24-pin NIF sockets (see text)
1 TO-220 heatsink, Thermalloy type 6030 or equivalent
6 rubber feet

***Semiconductors***

1 LM317 T 3-terminal adjustable regulator
1 7805T 3-terminal positive 5V regulator
1 7905T 3-terminal negative 5V regulator
1 7812T 3-terminal positive 12V regulator
12 1N4002 1A silicon diodes
1 1N4148, 1N914 silicon diode
1 BC327 PNP transistor
1 BC547 NPN transistor
2 red LEDs
1 4040 12-stage binary counter
1 4013 dual D flipflop
1 4093 quad Schmitt NAND gate
1 4049 hex inverter
1 555 timer

***Capacitors***

1 2200μF/25VW axial electrolytic
2 1000μF/25VW axial electrolytic
1 100μF/35VW axial electrolytic
1 100μF/63VW axial electrolytic
2 100/25VW PC electrolytic
1 47μF/25VW PC electrolytic
5 10μF/25VW PC electrolytic
1 10μF/63 VW PC electrolytic
4 10μF/16VW PC electrolytic
2 1μF/16VW PC electrolytic
2 0.1μF metallised polyester
1 .047μF metallised polyester
1 .039μF metallised polyester
2 .01μF metallised polyester

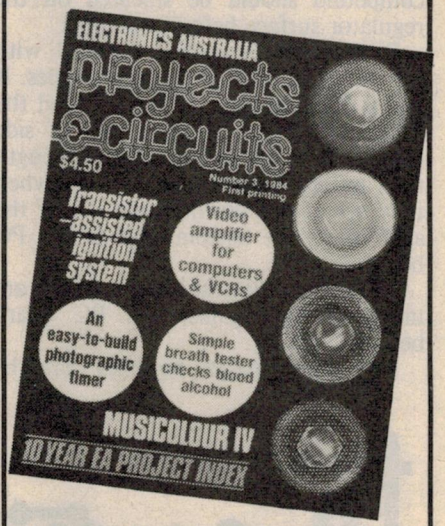
***Resistors*** (¼W, 5% unless specified)

1 x 1MΩ, 1 x 560kΩ, 1 x 270kΩ, 2 x 100kΩ, 1 x 47kΩ, 1 x 22kΩ, 1 x 4.7kΩ, 1 x 2.2kΩ ½W, 1 x 2.2kΩ ½W 2%, 1 x 1kΩ, 2 x 470Ω, 1 x 120Ω 2%.

***Miscellaneous***

Screws, nuts, tinned copper wire, PC stakes, solder, etc.


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If you like building electronic projects in your spare time, you can't afford to miss out on this exciting book of popular projects.

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**Miscellaneous**
Nail Finder; Portable 3½-Digit Heart Rate Monitor; 10 Year EA Project Index

Available from "Electronics Australia", 140 Joynton Avenue, Waterloo, Sydney, 2017, **PRICE $4.50** OR by mail order: Send cheque to "Electronics Australia", PO Box 227, Waterloo, 2017, **PRICE $5.40.**

although an equivalent heatsink made from scrap aluminium should also be satisfactory.

The Thermalloy 6030 measures 25mm x 30mm x 12mm (W x D x H). No mica washer is required but heatsink compound should be smeared on the regulator surface before assembly.

Some rotary switches supplied with kits may not be PCB-mounting types. If this is the case, you will have to cut the solder eyelets off using a pair of side cutters. Trim the switch shafts to length then mount the switches so that, when they are at mid-position, the flat of the shaft faces the bottom edge of the PC board.

Make sure that the switch bodies are mounted flat against the PC board before soldering.

The four toggle switches can be mounted either way round but pushbutton switch S6 must be oriented correctly. If you look closely at the switch body, you will see the following markings: C, NO and NC. Mount the switch so that the NC terminal is the one closest to the bottom of the PC board.

The EPROM sockets used in the prototype were low-cost NIF (no insertion force) types distributed in Australia by Mayer Krieg & Co (GPO Box 1803, Adelaide, SA 5001). These sockets are currently available from Jaycar, Geoff Wood Electronics and Radio Despatch Service, although other retailers should also have stocks by the time this article appears in print.

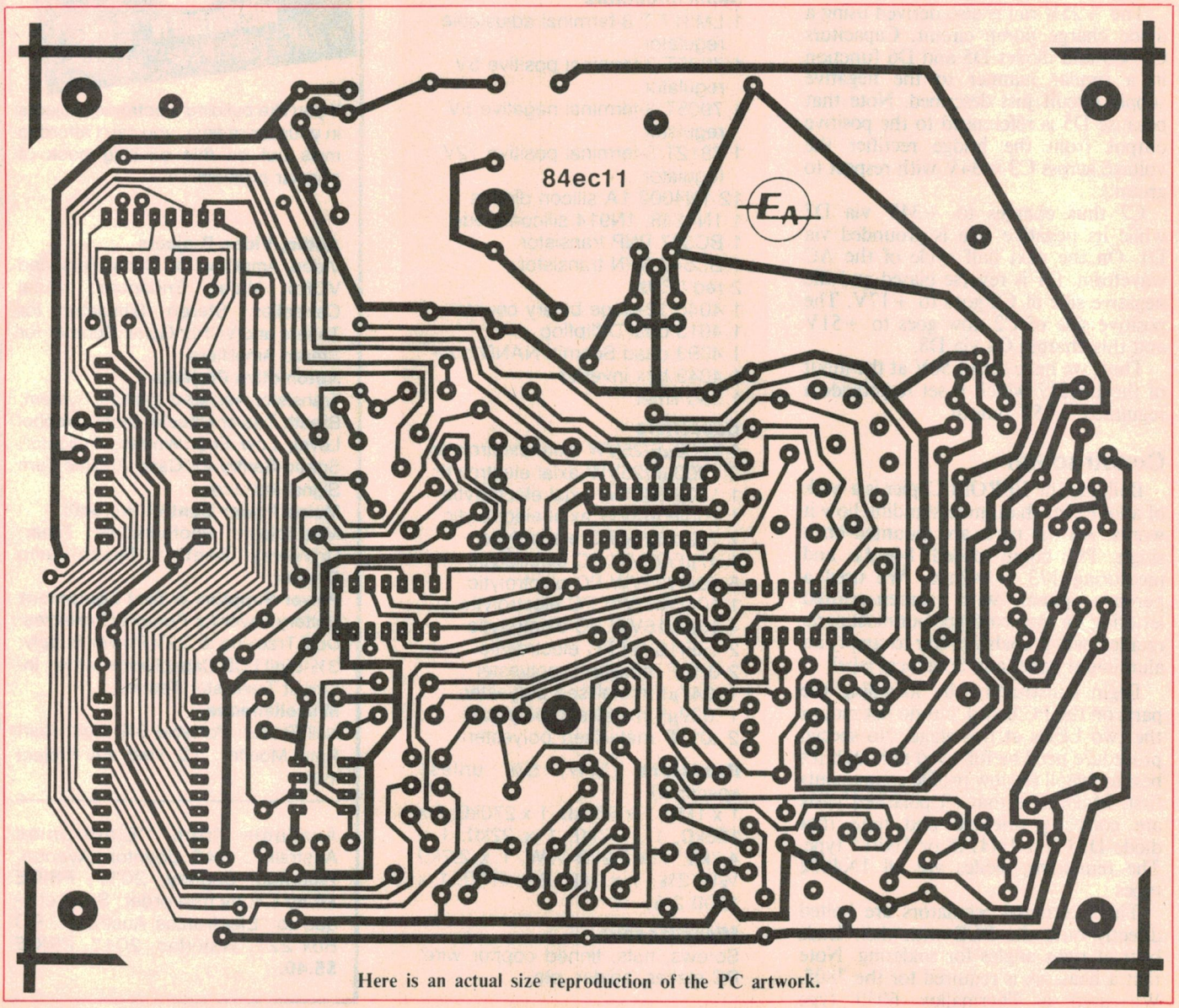
You can substitute lever-actuated ZIF (zero insertion force) sockets if you wish but note that these will cost more than the Mayer Krieg devices.

Once the PC board has been assembled, the six rubber feet can be fitted and attention turned to the front panel. Drill the necessary holes for the switches and LEDs, then mount the LEDs using bezels. The front panel can then be mounted on the switch bushings and the LED leads passed through their respective mounting holes on the PC board.

Pay particular attention to the orientation of the LEDs. The cathode of the Program LED goes towards the bottom of the board while the cathode of the Power LED goes towards the top.

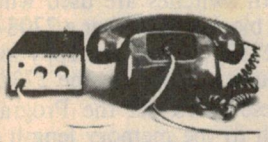
Note that the front panel is stood off the rotary switch bodies by means of washers and secured from above using locknuts. For the toggle switches, it is necessary to use nuts on both sides of the panel. The Program switch bushing is slightly shorter than the toggle switch bushing and should be left unused.

Construction can now be completed by hooking up the AC plugpack supply. We used PC stakes to terminate the plugpack leads, but these are optional.




Here is an actual size reproduction of the PC artwork.

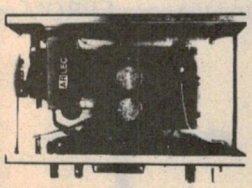
# Rod Irving TOP 20 Kits



## PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. '84).

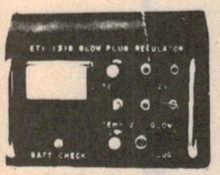
84TP2 **$24.00**



## DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. (EA March '82)

82PS2 **$87.50**



## MODEL ENGINE IGNITION SYSTEM

Get sure starts every time and no more glow plug burnouts on your model engines. (ETI June '83)

ETI-1516 **$41.50**



## TEMP PROBE

Can measure temperature from −50° to +150°C. It simply plugs into your multimeter — great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C. (ETI June '83).

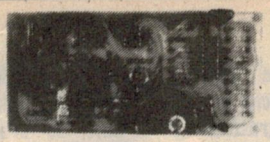
ETI-153 **$22.50**



## ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes. (ETI May '83).

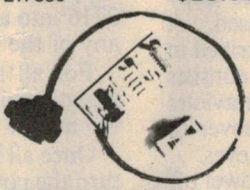
ETI-164 **$9.50**



## PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

No more fiddling with knobs and not getting the delay between wipes that you want — this windscreen wiper controller is simply programmed with two pushbuttons to provide the wiping delay you need. (ETI Mar. '83).

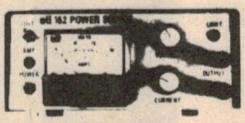
ETI-335 **$28.50**



## RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. '83)

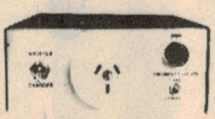
ET733 **$20.00**



## 30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec. '83).

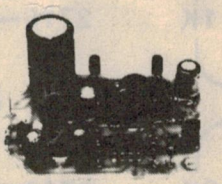
ETI-162 **$49.50**



## INVERTER

This 12 240V inverter can be used to power mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May '82)

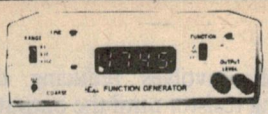
82IV5 **$49.50**



## PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds of perhaps even more sinister noises. The current cost of components for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov. '83)

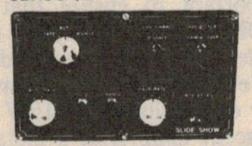
83MA11 **$15.00**



## FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. (EA April '82)

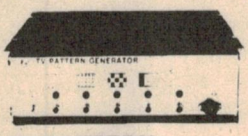
82AO3A/B **$79.50**



## SLIDE CROSS-FADER

Want to put on a really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. '81).

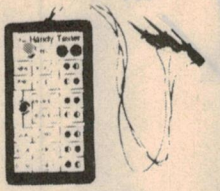
81SS11 **$85.00**



## TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns, dot, crosshatch, checker-board, grey scale and white raster. (EA June '80)

80PG6 **$67.50**

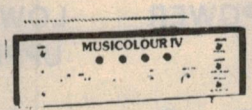


## TRANSISTOR TESTER

1000's SOLD

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83)

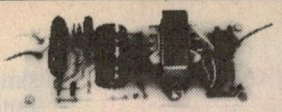
83TT8 **$15.00**



## MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety. (EA Aug. '81).

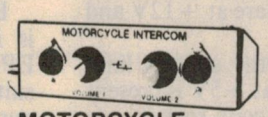
81MC8 **$84.00**



## ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82)

82EF9 **$19.50**

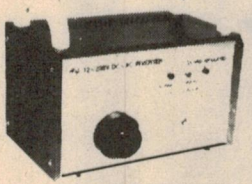



## MOTORCYCLE INTERCOM

OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build! (EA Feb. '84).

84CM5 **$36.50**



## 12-230V DC-AC INVERTER

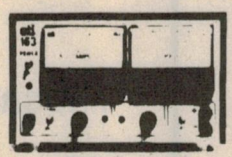
INCLUDING TRANSFORMER 300 WATTS

This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '82).

| | |
|---|---|
| **Nominal Supply** Voltage | 12V DC |
| **Output** Voltage | see table |
| **Frequency** | 50Hz± .005% |
| **Regulation** | see table |
| **Maximum Load** | 300VA |
| **Current Limiting** | 30A (primary) |
| **Efficiency** | see table |

P & P $10.00. Anywhere in Australia.

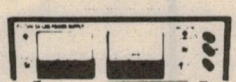
82IV6 **$195.00**



## LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by a unique relay switching system switching between taps on the transformer secondary. (ETI May '83).

ETI-163 **$175.00**



## 50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design. (EA May, June '83)

83PS5 **$140.00**

Errors and Ommissions Excepted


**Rod Irving Electronics**

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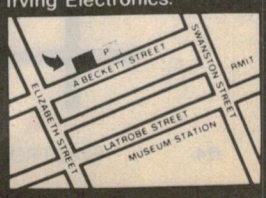
| | |
|---|---|
| $1-$9.99 | $1.50 |
| $10-$24.99 | $2.00 |
| $25-$49.99 | $3.00 |
| $50-$99.99 | $3.50 |
| $100-$199 | $5.00 |
| $200-$499 | $7.50 |
| $500 plus | $10.00 |

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# Eprom Copier

## Testing

The test procedure is quite simple. First, apply power and check that +5V is present on pin 24 of both the master and copy EPROM sockets. This done, set the master EPROM switch to the 2708 position and check that pins 19 and 21 of the master socket are at +12V and −5V respectively.

Check also that all the address lines (A0-A9) are low and that +5V is present on pin 21 (Vpp) of the copy socket.

Now press the Program switch. The Program LED should light and the Vpp line should go to +25V. If you have an oscilloscope, you can check for the 50ms pulse train on pin 3 of IC3.

Readers with an oscilloscope can also adjust the IC4b clock to obtain maximum copying speed. The procedure simply involves reducing the 270kΩ timing resistor until the output low at pin 4 just exceeds the 50ms programming pulse at pin 3 of IC2. If no CRO is available, then use a 270kΩ resistor if IC4 is a National Semiconductor device and a 560kΩ resistor for devices from other manufacturers.

## Operation

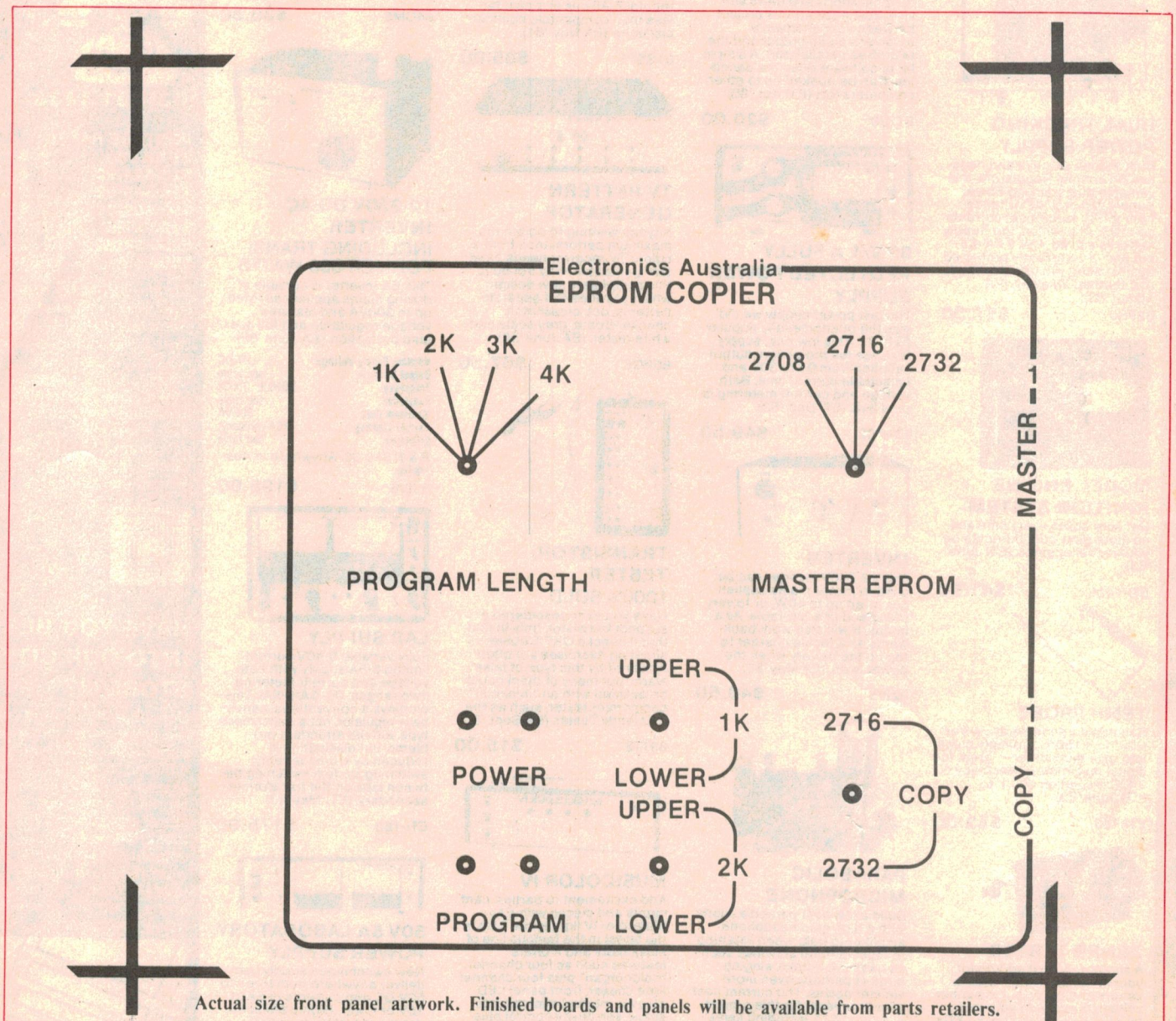
Before attempting to use the copier, it is important to ensure that the copy EPROM has been fully erased. A suitable EPROM eraser was described in our February 1979 issue and consists simply of a Philips TUV15W ultraviolet fluorescent lamp with a metal cover to prevent damage to the skin and eyes.

To use the copier, switch the power off and insert the master and copy EPROMs into their respective sockets with pin 1 at top left. If you are using two EPROMs of the same type, set the Program Length switch to 2K for 2716 devices and to 4K for 2732 devices. A lesser program length can be selected if the program falls within one of the available 1K blocks.

The Upper and Lower 1K and/or 2K switches are used only when the copy EPROM is different from the master. The 1K switch is used when copying from a 2708 into a 2716, the 2K switch is used when copying a 2716 device into a 2732 and both switches are used when copying a 1K block from either a 2708 or 2716 into a 2732, (ie, you can copy into any of the four 1K blocks in the 2732).

For all these cases, set the Program Length switch to the memory length of the master EPROM.

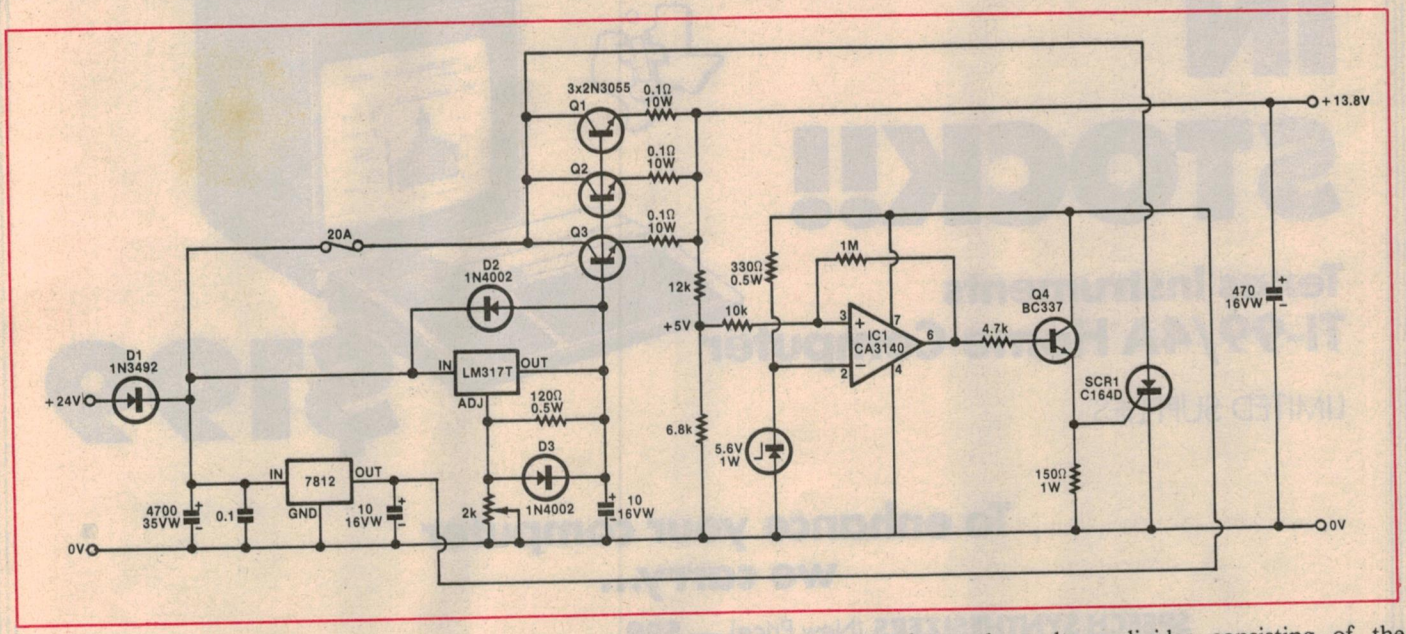
Once all the switches are correctly set, turn the power on and press the Program switch to initiate programming. When programming is complete, the program LED goes out and the copy EPROM can be removed.




Actual size front panel artwork. Finished boards and panels will be available from parts retailers.

# Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.




## 24 to 12 volt converter

This circuit should prove popular with truck and bus owners. The converter can power 12V equipment from a 24V battery at currents up to 20A. There is overvoltage protection which works by blowing the fuse if the regulated voltage reaches 15.5V

An LM317 three terminal regulator is used to control the paralleled transistors, Q1, Q2 and Q3. These provide the high current demanded by the load, while the regulator supplies base current to each transistor. The 0.1Ω 10W resistors in the emitter of each transistor ensure that the transistors source an equal share of the load current.

The regulator voltage is set by the 2kΩ trim potentiometer at the adjust terminal. Diodes D2 and D3 protect the regulator, while D1 protects the entire circuit from reverse polarity.

The overvoltage protection circuitry consists of IC1, transistor Q4 and the SCR. IC1 is connected as a Schmitt trigger to switch transistor Q4 when the regulated voltage level exceeds a certain level.

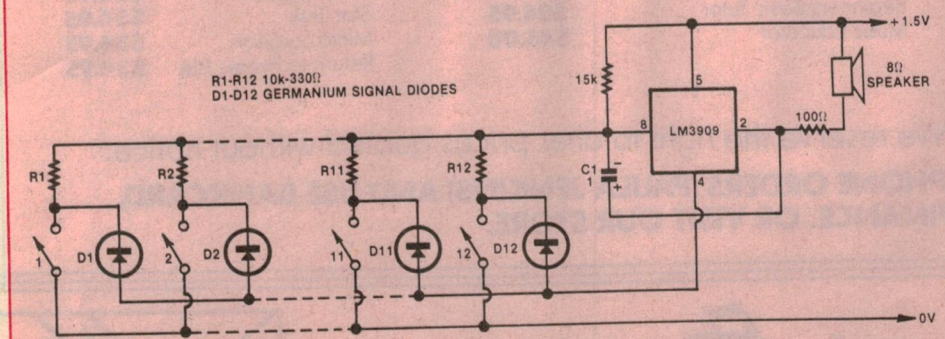
Pin 3 of IC1 is normally at 5V due to the voltage divider consisting of the 6.8kΩ and 12kΩ resistors. The inverting input, pin 2, is fixed at 5.6V by the zener diode. Should the regulated output voltage exceed 15.5V, the voltage at pin 3 becomes greater than 5.6V and the op amp output at pin 6 goes high, turning on Q4. This switches SCR 1 which shorts the supply via the fuse. The fuse therefore blows and removes power to the transistors.

A 7812 regulator supplies the positive 12V for the op amp and transistor Q4.

P. Howarth
Gunnedah, NSW. **$25**

## Simple monophonic organ

This simple organ circuit does not require an on-off switch and will run from a single 1½-volt battery. The heart of the circuit is the LM3909 which is normally used as a LED flasher but here it drives a loudspeaker.




The LM3909 functions as an astable multivibrator with its time-constant determined largely by one of the resistors R1 to R12 and the 1μF capacitor. Because of the diodes D1 to D12, only one resistor is brought into play at any given time. The resistor values may be selected initially by using trimpots which can then be replaced by fixed resistors.

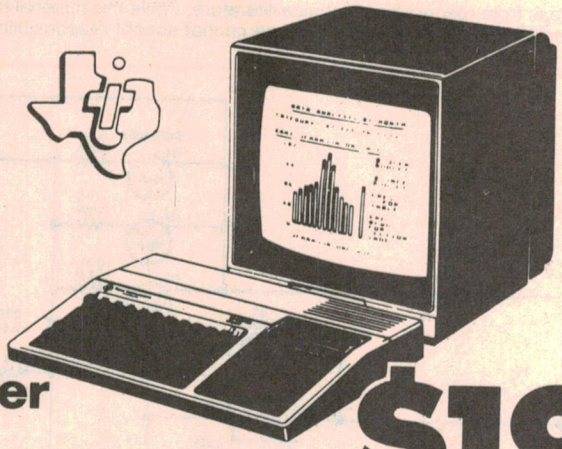
The 100Ω resistor minimises loading effects of the loudspeaker on the oscillator. Current drain when a note is played is about two milliamps.

E. Rodda,
Marion, SA. **$15**

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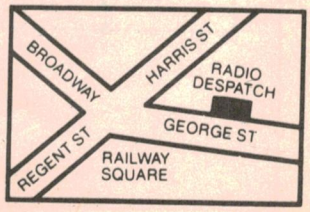
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# Circuit & Design Ideas

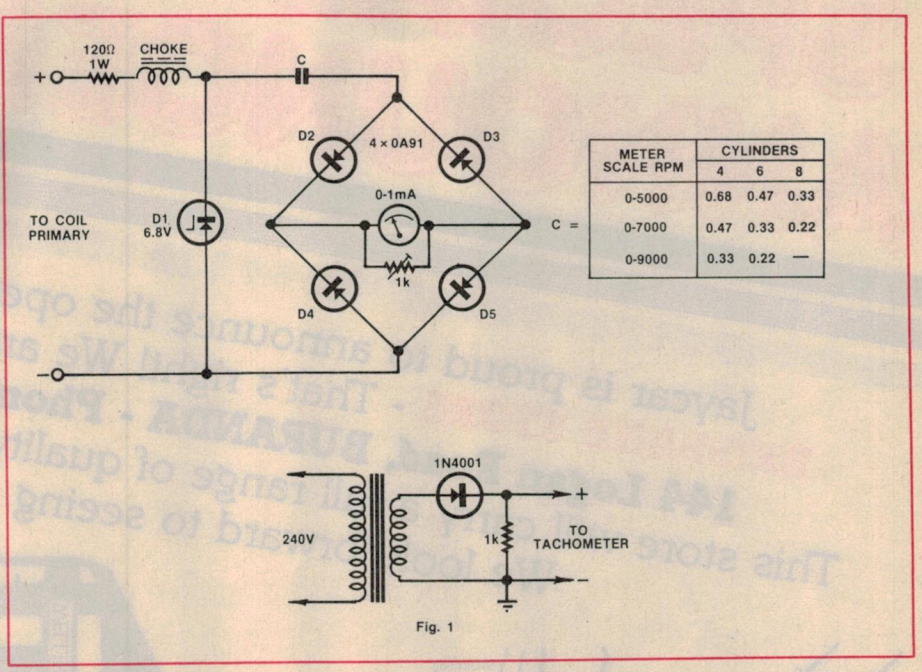
## Impulse tacho for Kettering & TAI systems

Here's an impulse tachometer circuit that will work with both normal Kettering and transistor-assisted ignition systems.

The circuit operation is straightforward, although the concept is hardly new. Basically, the voltage developed across the coil primary is clipped to produce a constant amplitude pulse train by the zener diode (D1) and differentiated by capacitor C. The resultant pulse train is then applied to bridge rectifier D2-D5 and thence to a 0-1mA meter movement.

The 120Ω resistor limits the current through the zener diode while the choke eliminates the high voltage peak generated by the coil when the points open (or the switching transistor turns off). The choke is made up by winding 480 turns of 0.2mm (36 SWG) gauge wire on a 25mm bobbin in a ferrite pot core.

To calibrate the unit, apply a half-wave rectified signal from a 12V AC transformer (see Fig. 1) and adjust the 1kΩ trimpot to read 1500rpm for a 4-cylinder engine, 1000rpm for a 6-cylinder engine and 750rpm for an 8-cylinder engine.



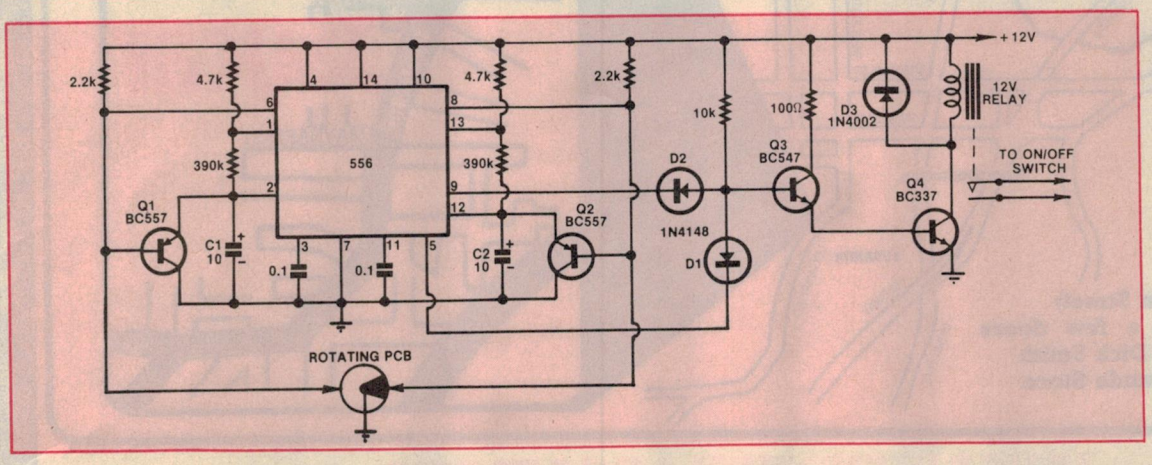

| METER SCALE RPM | CYLINDERS | | |
|---|---|---|---|
| | 4 | 6 | 8 |
| 0-5000 | 0.68 | 0.47 | 0.33 |
| 0-7000 | 0.47 | 0.33 | 0.22 |
| 0-9000 | 0.33 | 0.22 | — |

Fig. 1

L. Stott,
Yarragon, Vic. **$5**

Editor's note: this circuit first appeared in *Electronics Australia* in July 1964.

## Automatic turn-off switch




People who like to drift off to sleep to the sound of their 3-in-1 stereo set have a problem. The unit will play on all night. This circuit solves that problem by monitoring the rotation of the turntable or cassette drive motor.

The circuit can be regarded as a missing pulse detector. It is based on a dual 555 timer, each section of which operates as a retriggerable monostable. A disc is attached to the spindle of the cassette or turntable motor. As the conductive brushes pass over the grounded segment of the disc, Q1 or Q2 is turned on to discharge C1 or C2. At the same time, each time the base of Q1 or Q2 is grounded, the associated timer is triggered and begins its four-second cycle.

While ever the tape or turntable is running, the two monostables will be repeatedly re-triggered, thus keeping the outputs at pins 5 and 9 high.

This keeps the two diodes reverse-biased and so Q3 and Q4 are continuously turned on, energising the relay.

When the tape stops running, the disc will also stop turning and this will prevent the timers being retriggered. After about four seconds the outputs of the timers will go low, forward biasing diodes D1 and D2, this switches off transistors Q3 and Q4 which in turn switch off the relay supplying power to the stereo system.

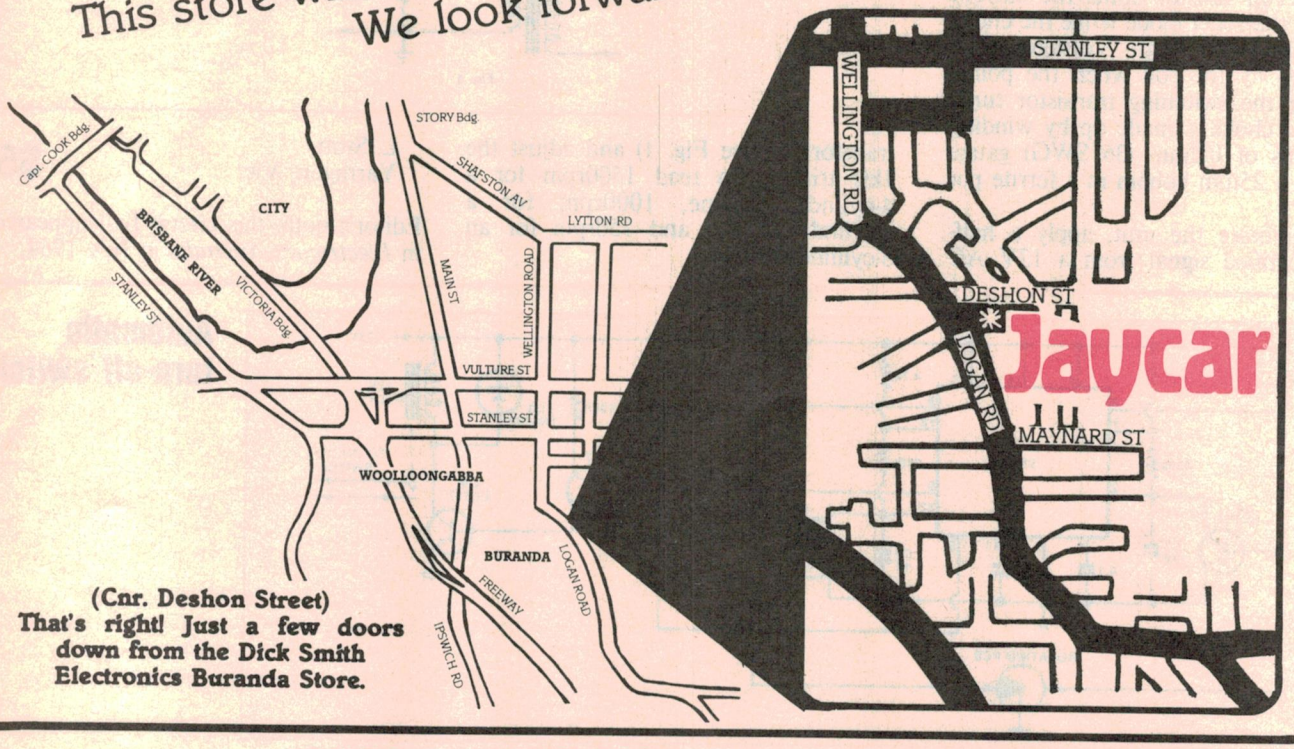
Two timers are required in this circuit in order to protect against the situation of a sensor brush stopping on the disc segment.

(Editor's note: The circuit is based, in the first instance, on the missing pulse detector published in the Signetics Linear Data Book, Vol 1, 1972 and in earlier Signetics data books.)

H. Velthuizen,
Porira, NZ. **$20**

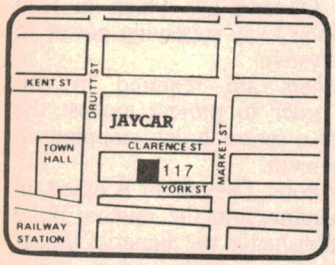
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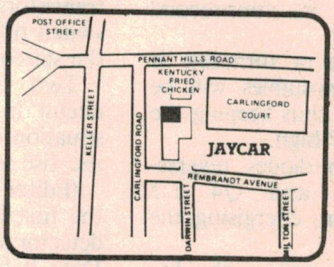



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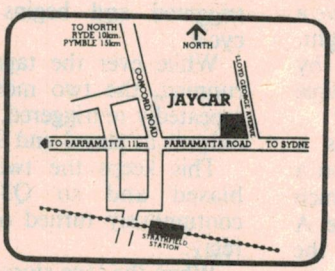
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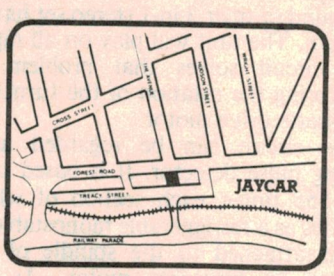

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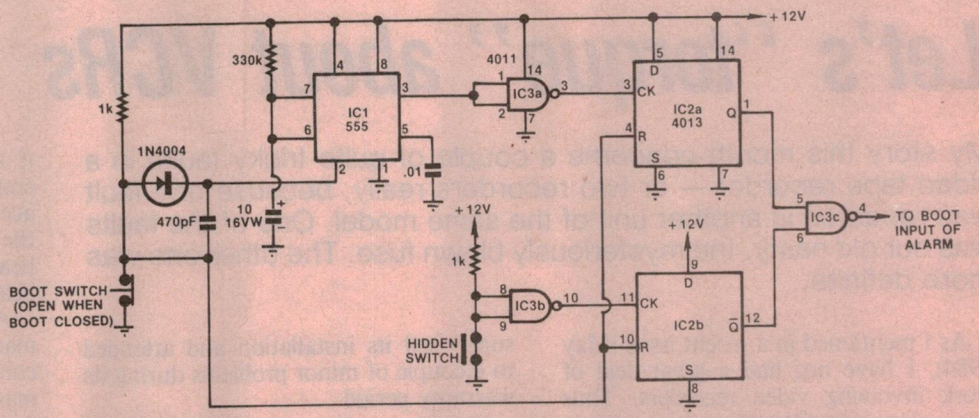

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# Circuit & Design Ideas

## Modification to the EA Car Alarm




A number of people have written to *Electronics Australia* commenting on one shortcoming of the car alarm published in the May issue. It is quite inconvenient to have to open the car and turn off the alarm if you only want to put something in the boot (for instance, when shopping). This circuit overcomes that problem.

When the boot is closed, the flipflops are held reset, so pin 1 of IC2a will be low and pin 12 of IC2b will be high. This will cause the output of NAND gate IC3c to go high. When the boot is opened, the reset line goes low and a negative going pulse is delivered to pin 2 of the monostable formed by IC1 and associated components. Pin 3 of this IC immediately goes high, and remains this way until the time period expires. With the component values shown this is about five seconds.

The output signal from the monostable is inverted by IC3a, and fed into the clock input of IC2a. Nothing will happen on the falling edge of this signal, but, on the rising edge, the output of the flipflop will go high. If there has been no change in the output of IC2b in the meantime, the output of IC3c will go low, triggering the alarm.

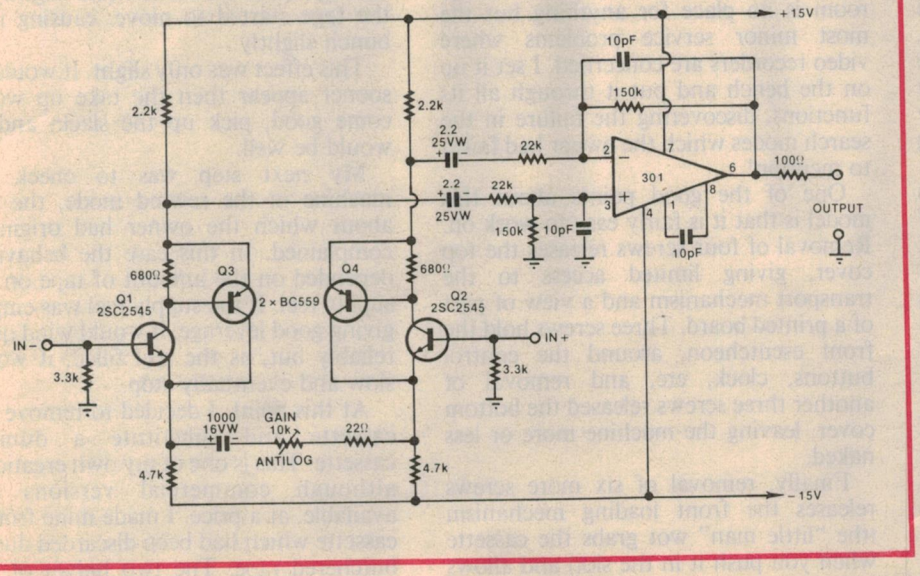
If the hidden button is pressed however, a rising edge will be presented to the clock input of IC2b. This will cause the output of this flipflop to go low. Now when the time period expires, and the output of IC2a goes high, there will be no change of state at the output of IC3c. In this case the boot may remain open indefinitely.

Andrew Rankin,
East Malvern, Vic.

**$20**

## Low-noise balanced input mic preamp

This preamp has been designed as an alternative to a transformer input stage for low impedance balanced microphones (150-600Ω).




Performance is very good, with a CMRR of 70dB, THD of less than .002% and noise within 2dB of the thermal noise limit (measured with 200Ω source impedance).

The circuit consists of two compound transistor pairs connected as a differential amplifier, and an op amp output stage. The first stage has a common mode gain control, allowing the gain to be adjusted over the range 15-60dB.

Low noise 2SC2545 transistors are used in the input stage, with BC559s to linearise their characteristics. The op amp is connected as a differential amplifier to provide an unbalanced output and to further remove any common mode input signal.

If an antilog pot cannot be obtained, a log pot may be used in its place. This will work fine, but in the opposite sense to normal. An improvement in the CMRR may be obtained by using 1% tolerance resistors throughout. A TL071 may be used in place of the 301 (delete the 10pF capacitor).

Phil Allison,
Summer Hill, NSW.

**$20**

# The Serviceman

# Let's "torque" about VCRs

My story this month concerns a couple of quite tricky faults in a video tape recorder — or two recorders really, because one fault was repeated in another unit of the same model. One of the faults was our old nasty, the mysteriously blown fuse. The other one was more definite.

As I mentioned in a recent issue (May 1984), I have not had a great deal of work involving video recorders. Thus far, customer problems have been mainly confined to installation situations: lead compatibility, an occasional antenna overhaul, and the usual troubles associated with a new piece of equipment which the user does not fully understand.

One reason for this situation is that most video recorders have been sold with a fairly generous guarantee period, up to three years in some cases, so that most of them are still covered and not likely to turn up on my bench. I also suspect that a lot of customers may hesitate to trust something as expensive and complicated to their local serviceman unless they have a lot of confidence in him. And I can't say that I blame them.

On the other hand I have been doing my best to prepare myself for the day when they do come my way. Having digested as much theory as possible. I was fortunate in being able to attend a couple of service seminars run by companies handling well-known brand names, see their service departments in action, and acquire some service manuals, special tools, gauges, etc, necessary for this kind of work. (Service manuals, incidentally, are very expensive; something which may discourage some servicemen from taking on recorder service at all.)

Having done all that I felt I was as well prepared as I could be, short of actual field experience; the kind of thing you cannot possibly acquire from service manuals or a one or two day seminar, no matter how concentrated the effort. So I simply waited, and the story I am about to tell concerns the first really tricky situation that I encountered.

The VCR involved was a Sharp model VC-9300, a fairly conventional, no frills model that has been on the market for about 18 months. It was purchased by one of my long-standing customers not long after they first appeared and I supervised its installation and attended to a couple of minor problems during its warranty period.

Not long after it was out of its guarantee period — inevitably as some cynics would say — it started to give trouble. Strangely enough the owner didn't complain about it immediately, mainly because it involved a function which he didn't use very much. More precisely it involved both the forward and reverse fast search functions. While these would operate normally most of the time, they would malfunction on odd occasions and trip the machine's overload protection circuitry.

But, as I said, the owner didn't worry much about it — at least initially — since it continued to operate normally in the record and replay modes, and in the fast forward and rewind (non-search) modes. The crunch came when the machine began baulking at the normal rewind function. Since this effectively put the machine out of action, he immediately sought my help.

Having confirmed the rewind fault in his home I brought the machine back to the workshop. The customer's lounge room is no place for anything but the most minor service problems where video recorders are concerned. I set it up on the bench and put it through all its functions, discovering the failure in the search modes which the owner had failed to mention!

One of the good points about this model is that it is fairly easy to work on. Removal of four screws releases the top cover, giving limited access to the transport mechanism and a view of part of a printed board. Three screws hold the front escutcheon, around the control buttons, clock, etc, and removal of another three screws released the bottom cover, leaving the machine more or less naked.

Finally, removal of six more screws releases the front loading mechanism (the "little man" wot grabs the cassette when you push it in the slot) and allows it to be moved to one side while still connected to its leads. This gives full access to the transport system, including the supply and takeup shafts, the video head drum, the sound and control track heads, the capstan, guides, etc.

And, happily for the serviceman, the machine will still function in this condition if a cassette is loaded into it manually. This allows all the mechanical functions to be checked visually as each is initiated.

This recorder uses four motors in all. There is the drum servo motor, the capstan servo motor, a loading mechanism motor, and a reel motor. The latter drives whichever spool is taking up tape, according to which way the tape is running. Selection of the appropriate function is by means of an idler pulley driven by the motor drive shaft pulley and which is moved from one spool drive to the other as required. A similar arrangement is found in a lot of audio recorders.

## Testing

I loaded a tape into the machine and selected the play mode. The tape threaded normally, paused briefly, then commenced to play, all of which was exactly as it should be. I put it through this sequence several times and, while it performed correctly most of the time, I did notice a fault. Every so often the take-up spool would hesitate slightly as the tape started to move, causing it to bunch slightly.

This effect was only slight. It would no sooner appear then the take up would come good, pick up the slack, and all would be well.

My next step was to check the machine in the rewind mode, the one about which the owner had originally complained. In this case the behaviour depended on the amount of tape on the supply reel. If the supply reel was empty, giving good leverage, it would wind quite reliably but, as the reel filled, it would slow and eventually stop.

At this point, I decided to remove the cassette and substitute a dummy cassette. This is one of my own creations, although commercial versions are available, at a price. I made mine from a cassette which had been discarded due to butchered tape. The two halves of the

## VCR service jigs and tools

*Involvement in VCR service will call for some additional tools, jigs and other test devices. Service manuals from various manufacturers recommend a whole range of such aids, some of them peculiar to a particular make or model, or simply favoured by that manufacturer. Others are universally acknowledged as being more or less essential for serious service work.*

*Undoubtedly the most popular device is the torque gauge. A typical version is illustrated and consists of a circular body fitted with a three-jaw chuck at one end and a circular dial and pointer at the other. The chuck can accept a number of adapter heads, including ones to fit VCR and audio recorder drive spools.*

*Its mechanism is a simple loading spring which opposes the driving force until it stalls it, and displays this setting on the dial. In most cases the drive chain under test will slip, but in more direct systems the motor may also be stalled.*

*Next in popularity would be some form of back tension measuring gauge. As its name implies, it is used to check the back tension on the tape provided by the supply reel, usually by means of a friction clutch or tension band. Two devices are commonly used; a back tension cassette and a tape tension gauge.*

*The cassette is similar to a normal tape cassette but is fitted with a slipping clutch or similar mechanism and a dial which displays the tension in g-cm. The tape tension gauge is a three pronged device, with the three prongs slightly out of line and through which the tape is threaded. The tension created by the moving tape is displayed on a dial in g-cm.*

*Another tool is a simple spring type tension gauge used to check the pressure of pinch wheels, idler pulleys, etc. It needs little comment.*

*In many cases the above, together with cleaning solutions, etc, should be sufficient for most routine checks and adjustments. More complicated repairs, such as head or drum replacements may call for a lot more specialised equipment.*

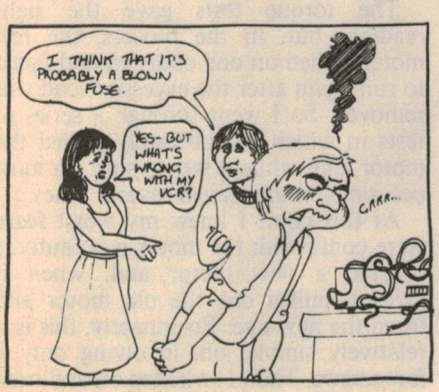
*Various test tapes are also available, carrying precision test patterns, and which would be needed for audio, control or video head and drum adjustments. Unfortunately, they can be quite expensive, often leaving little change out of $300. They would be more suitable for a large specialist organisation than the average small service shop.*

*As a counter to this some colleagues have made their own tapes, using test patterns from their colour bar generator, plus some that are available off-air. While not as good as the professional versions, they are very useful for all but the most exacting tasks.*

body are held together with five Philips head screws and, with these removed, the whole thing comes apart.

The tape and internal reels are discarded and the clear plastic sections in the top half knocked out. Some weight is added to compensate for the discarded tape, then the two halves reassembled. The result is a dummy cassette which will operate all the sensors in a recorder, both mechanical and optical, and trick it into believing that it has a normal cassette on board. At the same time it provides access to the supply and take-up reel "discs" (as they are called in the manual) which engage the internal toothed reels in the cassette.

This, in turn, permits fitting a torque gauge to these drives and then comparing the result with the recommended values in the manual. These are given in g-cm and, for the supply reel drive in the rewind mode, this should be around 800. The same applies to the take-up reel drive when in the fast forward (non-search) mode.




In fact, the values determined by the gauge were quite erratic. While, at times, they came up to the 800 mark, they could also drop as low as 100, with values in between most of the time. Nor was it hard to work out what was wrong; the drive from the reel motor via the idler pulley was slipping.

Closer examination confirmed that the idler pulley, in particular, appeared to have acquired an oily coating of some kind. I am not sure as to the source of this, though I feel quite sure that no one had been tampering with the machine. My strongest impression is that the tyre on the idler pulley, made from some rubber like composition, was to blame, apparently being chemically unstable and tending to disintegrate. But that is only speculation.

Anyway, regardless of the source, the drive system had to be thoroughly cleaned, which I did using a pure alcohol based cleaning fluid. In fact, I went through the cleaning process no less than three times, with appropriate drying periods in between, before I felt that the job had been successful. The final check, of course, was with the torque gauge, which confirmed that there was now a consistent 800g-cm torque.

At the same time, I checked the torque in the play and search modes. The torque requirements here are much less, in the order of 175g-cm and, in fact, the 800g-cm figure would be far too high for this mode. These checked out OK.

So things were looking a lot more promising, but I took the opportunity, while the rest of the mechanism was accessible to check the video drum, video heads, sound and control heads, capstan guides, etc. And, while the machine was fairly new, there was a significant built-up of foreign matter on these parts. I spent some time cleaning them all, using the same cleaning fluid.

I kept the machine in the workshop for a couple of days, putting it through its paces at fairly frequent intervals, but was unable to catch it out. Eventually I returned it to the customer and hoped that I would hear no more about it for a long time.

### No such luck

Well, it didn't quite work out that way. I heard nothing about it for about four months, by which time I had more or less forgotten about it. Then the customer was on the phone with a tale of woe about the machine having gone completely dead. To give him his due, he wasn't blaming me and, in fact, hesitated when I suggested he bring it straight in, it being a Saturday afternoon when I'm normally closed. But it happened to be convenient and I was anxious to know what I might have overlooked.

On the bench his description proved to be absolutely correct; it was completely dead, with not even a clock display. My first thought, naturally enough, was a fuse failure, plus whatever might have caused it. The power supply is a fairly conventional arrangement, using a power transformer with low voltage secondary, bridge rectifier, and chopper type regulator delivering a main supply rail of about 13V.

There are two fuses in the system: a T630mA delay type fuse (F901) in the.

transformer primary circuit, and a T2.5A (F9001) delay type between the secondary and the bridge rectifier. I removed the covers and went first to the primary fuse, mainly because it is quite easy to get at. It looked to be intact, and the ohm meter across its contacts confirmed this.

The secondary fuse, unfortunately, is less accessible. It is down in the bowels of the machine and takes quite a bit of juggling to reach. But it was worth it, at least in the sense that it had failed, and thus explained the total failure. Why it had failed was another matter, but it appeared to be a simple failure, with no signs of distress.

Naturally, the first thing to do was to try another fuse. As it happened I didn't have that type of fuse in stock. There has been a temporary supply shortage and I didn't expect new stocks for about a week. In the meantime I settled, as an emergency measure, for a 3A fast flow fuse. At least it would give some idea of what might be wrong.

So I fitted this fuse, put everything back together, crossed my fingers, and switched on. And lo and behold, everything worked. No signs of distress and all systems go. So why had it failed? According to the customer it had failed while the machine was in operation, and I tried to determine in what mode it had been when it failed. With four different motors and associated circuits which could fail, knowing the mode involved could save a lot of time.

Strangely enough the owner didn't know. He thought it was in the play mode, but couldn't be sure; it might have been in the rewind mode. Oh well, it was worth a try. Naturally I wasn't exactly happy with the situation. A blown fuse with no obvious reason suggests an intermittent; and one which will wait until the machine is back in the customer's home before it shows.

Fortunately, the owner was quite understanding when I said I wanted to keep it under observation for a few days. In fact, I kept it for over a week; switching it on and off, putting it through all its operating modes, and even trying to trick it by changing my mind half way through an instruction. All to no avail; it worked perfectly every time.

Finally I shrugged my shoulders, put it down to a faulty fuse, and rang the customer to come and pick it up. Then I moved it to another bench and decided to give it one more check before fitting the correct T2.5A fuse, which had since come to hand. I switched it on, the clock display came up, and I loaded a cassette. Then it went dead; just like that.

A quick check on the fuse situation revealed that the 3A temporary fuse I had fitted had failed and, while I was about to replace it anyway, I was still puzzled as to why it had chosen that moment to fail, after all the testing I had done during the previous week. Anyway, I fitted the correct fuse and prepared to try again.

It quickly became clear that all was not well. The supply reel was not taking up properly in the reverse search mode, and similarly for the take-up reel in the play or forward search mode. On the other hand, for the moment at least, it was still functioning in the fast forward and rewind modes.

So it was out with the torque gauge again and more measurements in the faulty modes. As previously mentioned, these should be about 175g-cm but, in fact, were only about 100. A quick check around the idler pulley, etc confirmed that there was no slippage there and that it was the reel motor itself which was not delivering the torque.

## Torque adjustment

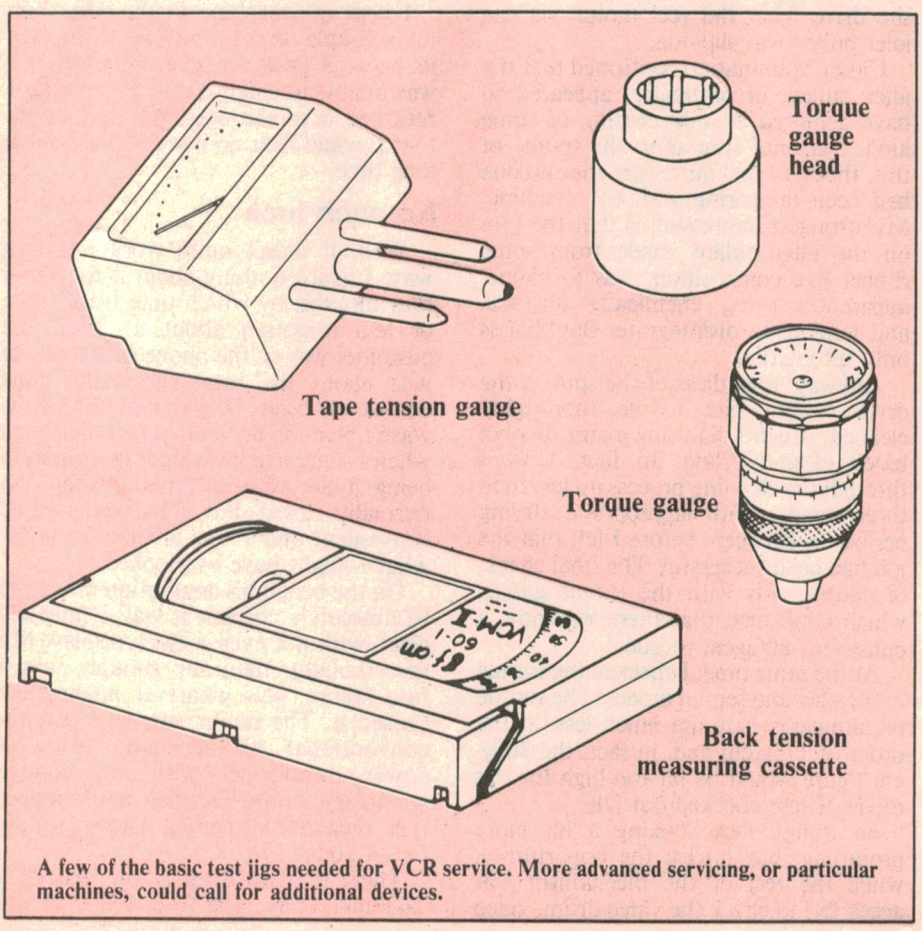
Which brings me to the method of varing the torque, according to the particular mode involved. The circuit is fairly complicated but, basically, consists of a control transistor (Q7754) in the motor supply line, this transistor being controlled, in turn, by an IC (7751). The end result is that the motor has the full 13V applied to it for fast forward and rewind functions, but a much lesser voltage for the lower torque functions.

The actual value of lower torque can be adjusted by means of a variable resistor (R7765) associated with IC7751 and I went through the motions of adjusting this, in an effort to increase the torque. In fact I succeeded in getting it up to the prescribed figure, but only by setting the control to its extremity.

I wasn't particularly happy with this situation, but proceeded to put the machine through a further series of tests anyway. This included all the normal operating functions, which it seemed to handle satisfactorily, plus some more torque tests after several runs.

The torque tests gave the right readings but, in the process, the reel motor stalled on one occasion and failed to run again after the excessive load was removed. So I went through a series of tests in which I deliberately stalled the motor and, while it would start on most occasions, it also failed several times.

At this point I knew my worst fears were confirmed; the motor was faulty. I ordered a new motor and, when it arrived, pulled out the old motor and fitted the new one. Fortunately, this is a relatively simple job, involving only a few screws. Then I switched on and tried




**A few of the basic test jigs needed for VCR service. More advanced servicing, or particular machines, could call for additional devices.**

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## LATEST IC'S INTO STOCK

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|---|---|
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| MC3340P | 1.65 |
| MC3470P | 7.93 |
| MC4024 | 6.90 |
| SY6502 | 10.81 |
| SY6522 | 11.12 |
| SY6532 | 11.57 |
| MC6802P | 10.68 |
| MC68B09P | 17.50 |
| MC6821P | 3.75 |
| MC6840P | 9.00 |
| MC6850P | 4.37 |
| MC14174BCP | 1.48 |
| MC1457P | 7.62 |
| MC1458P | 10.66 |
| MC14490P | 7.36 |
| MC146818P | 14.78 |
| 7555 | 1.95 |
| 7556 | 3.24 |
| ICL7660CPA | 4.80 |
| ICL7106CPL | 12.72 |
| ICL7107CPL | 12.72 |
| LM723CN | .86 |
| LM10CLN | 4.59 |
| LM3914N | 3.55 |
| LM3915N | 3.55 |
| LM3916N | 3.55 |

## GPD-3020 DUAL POWER SUPPLY

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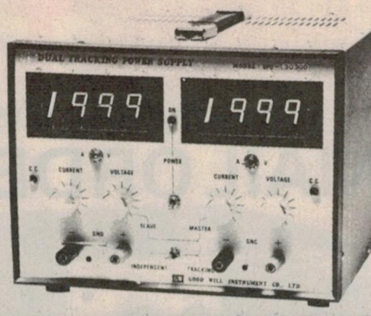



**$ 441 .00**

## GPD-3020D DUAL POWER SUPPLY

**Provides dual 0-30V, 0-2A**

Similar specs to GPD3020 but incorporates 3½ digit displays for greater accuracy.




## D CONNECTOR COVERS

| | |
|---|---|
| DE9 9 pin | $2.20 |
| DA15 15 pin | 2.35 |
| D1325 25 pin | 2.70 |



## "RADIAL" BNC COMPONENTS



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|---|---|
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| Bulkhead mounted | $1.89 |
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| Single terminal adaptor | $6.50 |

## FERGUSON LOW PROFILE TRANSFORMERS

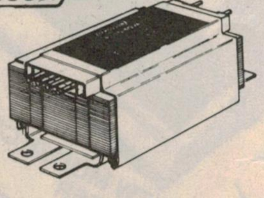
Dual secondary windings. Australian made to Australian standards. Telecom approved (RA78/151).

**20VA TYPES**

| | Series | Parallel |
|---|---|---|
| PL12/20VA | 6-0-6V @ 1.67A | 6V @ 3.33A |
| PL15/20VA | 7.5-0-7.5V @ 1.33A | 7.5V @ 2.67A |
| PL18/20VA | 9-0-9V @ 1.11A | 9V @ 2.22A |
| PL24/20VA | 12-0-12V @ 0.83A | 12V @ 1.67A |
| PL30/20VA | 15-0-15V @ 0.67A | 15V @ 1.33A |
| PL40/20VA | 20-0-20V @ 0.50A | 20V @ 1.00A |

**ALL $16.70 EACH**

FERGUSON



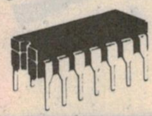
**40VA TYPES**

| | Series | Parallel |
|---|---|---|
| PL12/40VA | 6-0-6V @ 3.33A | 6V @ 6.67A |
| PL15/40VA | 7.5-0-7.5V @ 2.67A | 7.5V @ 5.33A |
| PL18/40VA | 9-0-9V @ 2.22A | 9V @ 4.44A |
| PL24/40VA | 12-0-12V @ 1.67A | 12V @ 3.33A |
| PL30/40VA | 15-0-15V @ 1.33A | 15V @ 2.67A |
| PL40/40VA | 20-0-20V @ 1.00A | 20V @ 2.00A |

**ALL $18.50 EACH**

## NATIONAL SEMICONDUCTOR

| | |
|---|---|
| MF5CN Single active filter | $ 2.97 |
| MF6CN-50 6th order CMOS | 3.85 |
| MF10CN Dual active filter | 4.66 |
| MM58167AN Real time clock | 18.69 |
| MM58174AN Real time clock | 17.20 |
| MM54240 Asynch Tx/Rx | 11.04 |
| MM53200 Digital code Tx | 6.66 |



## DIGITAL/ANALOG CONVERTERS

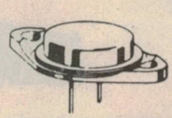
| | |
|---|---|
| DAC08800LCN | $ 3.82 |
| DAC0808LCN | 3.26 |
| DAC0830LCN | 8.57 |
| DAC0831LCN | 7.59 |
| DAC1000LCN | 14.10 |
| DAC1006LCN | 14.10 |

## ANALOG/DIGITAL

| | |
|---|---|
| ADC0800PCD | $22.40 |
| ADC0808CCN | 13.85 |
| ADC0809CCN | 7.25 |
| ADC1210HCD | 74.26 |

## ADJUSTABLE 10A REGULATOR

| | |
|---|---|
| LM396 positive | $24.96 |



## SPECIALS

| | |
|---|---|
| CD4503/80C97 | 87¢ |
| CD4007CN | 30¢ |
| CD4015CN | $1.20 |
| MM2114N-055 | 50¢ |
| ADD3501CCN | $10.50 |

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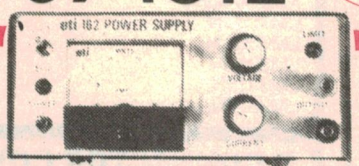
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| $100 or more | - | | $7.50 |

again, one of the first tests being a torque measurement. Not surprisingly it was way up; around 250g-cm and I had to reset the control close to its original setting to get the right reading.

I put the machine through another lengthy testing period and it behaved faultlessly; nothing I could do would upset it. So I finally put it all back together and returned it to the owner — with all fingers and toes firmly crossed!

But it wasn't my lucky week. Within three days the owner was on the phone again with the bad news that the machine had gone dead again. By this time I was heartly sick of the whole situation, and wishing I had never seen the accursed machine. But I hid my feelings and invited the owner to bring it in straight away. I was prepared to bet anything it was another fuse, but I didn't have a clue as to the reason.

As soon as it arrived I pulled the covers off and checked the T630 mains fuse. And that was it, open circuit. But why? I pulled it out and, fortunately, did not discard it, though this was pure good luck. I fitted a new one, switched on, and everything worked. Frankly, I didn't know what to think. Why another fuse failure, and why this fuse on this occasion? I couldn't escape the feeling that they were taking it in turns to pack up.

It was while I was musing thus, and talking to the customer while letting the machine run, that I picked up the old fuse and took another look at it. Imagine my surprise when I found that it was not a T630mA as it should have been, but a 400mA type. The whole situation presented more mysteries than I could explain.

For a start, how did that wrong fuse come to be there? The machine had never been serviced by anyone but myself so the only conclusion I can come to is that it was a factory mistake. Which, I suppose, is not impossible.

But even if we accept this, there remains the puzzle as to why, during the previous overload conditions, the 2.5A fuse, and then the 3A fuse, failed while the under-rated fuse held. And why had it chosen this time to fail when there appeared to be no fault condition?

I toyed with the idea that the previous overload conditions had stressed the 400mA fuse, introducing some metal fatigue, and thus hastening its demise, but I'm not fully convinced. And, as if to add further confusion to the mystery, I encountered a similar situation in another machine of the same make and model which I handled while battling with the first one.

This came in because it was completely dead and I went straight to the T630mA fuse, It was open. I replaced it and the machine played, but was exhibiting all the symptoms of slipping drive, as in the first one and for the same reason. I cleaned everything up as before, including the heads and drum, gave it a prolonged series of tests, and returned it to the customer.

That one lasted a couple of weeks and then the customer was on the phone with the same old story; machine completely dead. Needless to say it was another fuse, only this time it was the T2.5A in the secondary circuit. I replaced it, the machine worked, I gave it a thorough workout, and could find nothing wrong. I eventually returned it to the customer. That was many weeks ago and all is well so far. But note that the sequence of fuse failure was the opposite of that with the first machine.

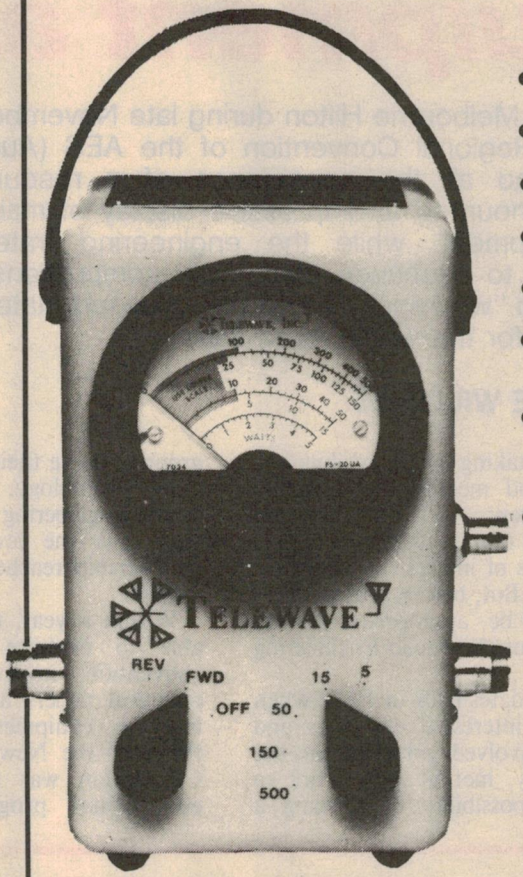
And that one has also been back with the customer for many weeks, and is still running. But don't ask me to explain why, or lay any bets as to how long the situation will last.

As I said at the beginning, there are an awful lot of things — and I use the word awful advisedly — which happen in the field that one never learns about in the service manuals or the classroom.


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# AES Melbourne convention:

## *Professional audio equipment and expertise*

Held at the Melbourne Hilton during late November, the first ever Australian Regional Convention of the AES (Audio Engineering Society) had all the appearance of a resounding success. Exhibitors mounted an impressive display of mainly professional audio equipment, while the engineering fraternity took the opportunity to exchange ideas in a comprehensive program of lectures and "workshop" sessions. I was fortunate in being able to be present for the whole three days.

**by NEVILLE WILLIAMS**

Apart from taking in the exhibits and lectures — and meeting up with old friends and new — I also had the opportunity to test industry reaction to several subjects of interest to readers of this magazine. But, before getting on to that, it may be appropriate to say something about the Audio Engineering Society itself.

The Society dates back to 1948, when a number of interested engineers and technicians, involved primarily in the record industry, met in New York to examine the possibility of forming a group to serve their common interest in audio technology. Out of it came the Audio Engineering Society, or AES, and such was the level of support that membership reached 500 within a few months.

Within a year, the new Society was able to organise its own full-scale convention, involving a program of technical papers and an exhibition of industry equipment occupying three floors of the New Yorker Hotel. The Convention was followed up by an educational program and by the production of Vol. 1 No. 1 of the Society's now well known "Journal".

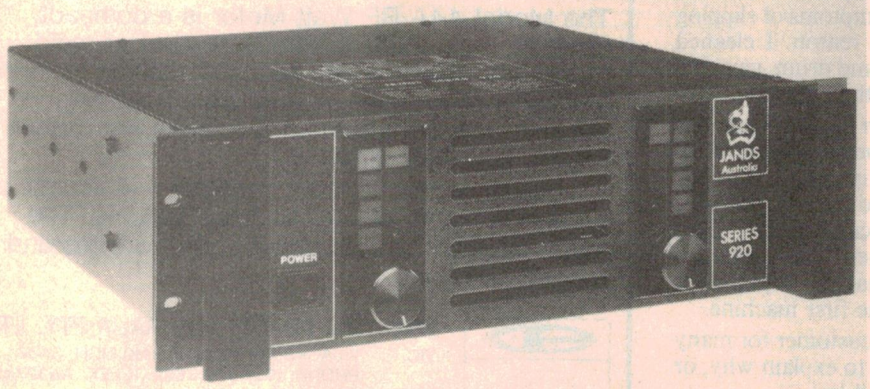


**Convention Committee member and official photographer, Max Hull is also a long-time member of the WIA and an active amateur.**

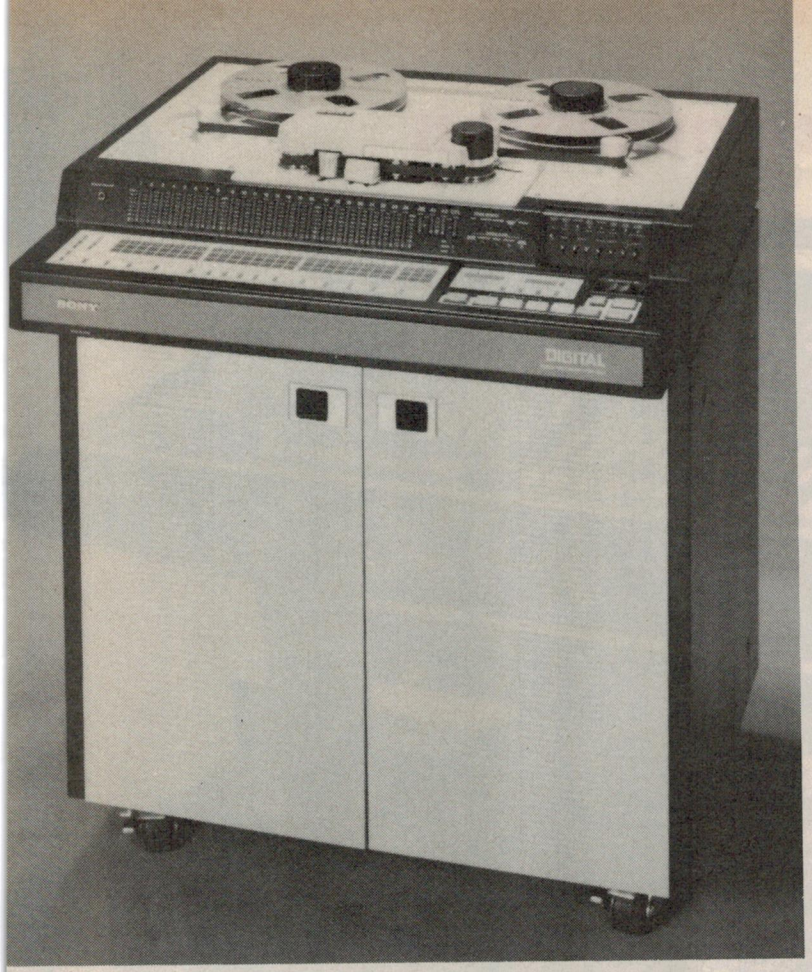
A West Coast section was established in 1949, with yet another in the Mid West in 1950. The first regional convention was held on the West Coast in 1954.

With the "Journal of the AES" gaining rapid acceptance overseas, further Sections were established in Japan, Great Britain and continental Europe, the first overseas regional convention being held in Cologne, West Germany, in 1971. Latest figures from the AES indicate a current total of 44 sections, drawing their members from no less than 71 countries.

As for Australia, sections were established in Melbourne and Sydney in 1972, and in Adelaide in 1981. Unfortunately, the Sydney section lapsed, perhaps because Sydney is the headquarters of the IREE (Institution of Radio & Electronics Engineers Aust) which has its own provision for special




**Made in Australia by Jands Electronics, this Series 920 power amplifier offers 450W per channel into 4 ohms, both channels driven, with less than 0.02% THD. Smaller amplifiers in the series are rated at 350W and 200W per channel.**



**Offering superb results plus the economy of 12.7mm tape, this Sony PCM-3324 provides digital recording of 24 separate tracks with a 20-20,000Hz response, 90dB S/N ratio and no print-through. It also provides two supplementary analog tracks and tracks for control signals and time codes.**



**Regular demonstrations were presented by Fairlight Instruments, plus a two-hour workshop on "Computers and Music" hosted by Peter Vogel. Also on display was their new CVI — Computer Video Instrument.**

interest groups, including one devoted to audio. As one member put it: "There is a practical limit to the number of such activities one can support".

Membership of the AES is structured along normal Learned Society lines. Full Members must have formal qualifications or equivalent professional experience, but there is provision also for Associate Members and Student Members. Inquiries about membership, fees, publications, etc can be directed to: Audio Engineering Society Inc, Melbourne Section. Box 131, GPO, South Melbourne, Vic 3205.

## Melbourne convention

Arrangements for this first Australian Regional Convention were handled by a committee of 13, headed up by Brian Horman (Klarion Enterprises Pty Ltd), with Robert Bywater (Monash University) responsible for lecture arrangements, John Smyth for exhibits and Graham Haynes (Teac) for publicity. Official AES photographer for the occasion was Max Hull, well known to long-term readers of this magazine as a radio amateur, Managing Director of William Willis & Co and a Director of East Recording Co.

As a measure of the Committee's success, the final Convention program listed something like 35 major exhibitors, occupying more than 40 stands and suites. The technical program involved about 25 papers and workshop sessions, 10 of which were presented by overseas visitors.

One thing is certain: delegates had no reason to complain about having insufficient to keep them occupied. Time had to be rationed between lectures, exhibits and technical "nattering".

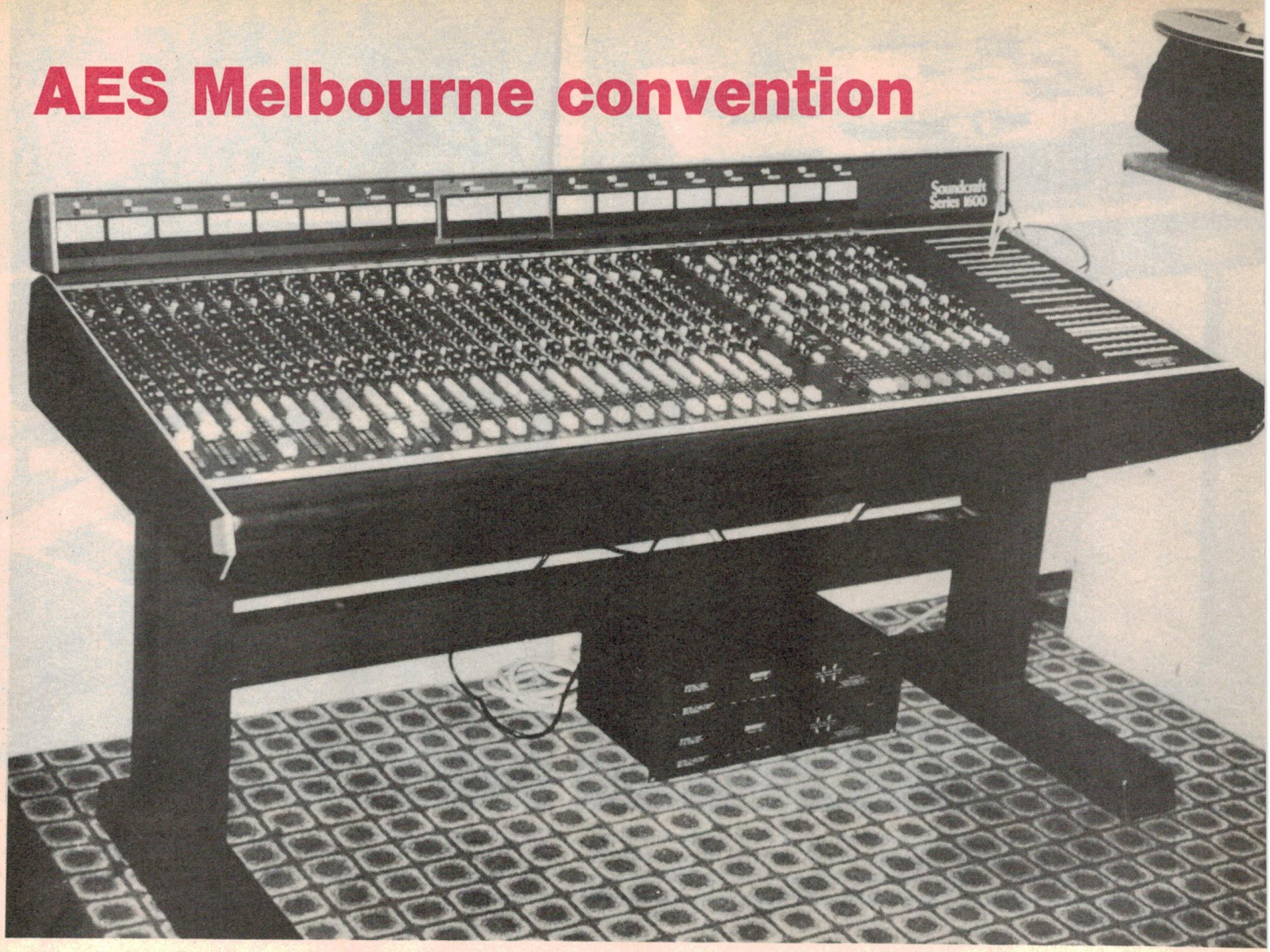
Convention activities began with an informal reception at the Melbourne Arts Centre on the evening of September 24. I spent a fair proportion of the time with Denis Vaughn (Acoustic Advisory Group) discussing the texture of orchestral and choral sound, as perceived by a technically aware conductor. It was an enlightening discussion, which I would like to develop on some future occasion.

The formal Convention program was opened on the following morning by Raymond E. Cooke OBE, President of Audio Engineering Society Inc. I first knew of Raymond Cooke as the Technical Director of Wharfedale and co-author with the late Gilbert Briggs, but he resigned that position in the early '60s to found KEF Electronics, manufacturers of the prestigious KEF loudspeakers.



**According to Sony "the broadcast industry needed a better way to manage the multiple audio, video, film and special effects units based on the SMPTE/EBU time code". Their answer, exhibited at the Melbourne AES, was this new Sony Sync Master.**

# AES Melbourne convention




**Large mixing consoles seemed to dominate the displayes. This 24-channel series 1600 Soundcraft was exhibited by Klarion Enterprises P/L.**

In his President's Message, Raymond Cooke congratulated the Melbourne Section for their initiative and effort in arranging the convention, at the same time paying tribute to engineering skills in this part of the world. I quote:

**"During the last two decades, Australasian engineers have made important contributions to the knowledge and understanding of audio matters ... out of all proportion to the population of their region. Names such as Cherry, Small and Thiele are now as familiar in Europe and North America as those of indigenous talents."**

(All three contributed papers to the Convention.)

As the ancient and now retired Editor-in-Chief of this magazine, it fell to my lot to address delegates and their guests, following the Convention banquet.

Being a social occasion, I took as my main theme "Audio: A Century of Argument", highlighting the many and varied "debates", over the years, between purists and technocrats. For example: mechanical v electrical reproduction in the '20s; triode v pentode tone in the '30s; the sweetness of thorn needles in the '40s, and so on. Not surprisingly, the address prompted its share of comment, over coffee, during the following two days.

## The exhibits

As mentioned earlier, the exhibits were dominated by professional audio equipment and most obviously — because of their sheer size and impact — by a whole array of multi-channel studio mixers. But, intermingled with them were racks upon racks of high-technology equipment, tape recorders of every conceivable shape and size, large amplifiers, and large (even huge) loudspeakers and systems, microphones galore and, everywhere, screens displaying video images, data of various kinds and multi-coloured bargraphs depicting audio frequencies and amplitudes.

Looking around the displays, one thing was immediately apparent: the multi-national sourcing of modern professional audio equipment. Otari was there with the latest analog recorders, Sony with up-to-the-minute digital, Yamaha with their keyboards, and so on, but the Japanese merely share the professional audio scene; they certainly don't dominate it, as they do the consumer level market. The rest of the equipment comes from around the world — typically USA, Canada, UK and continental Europe — with names like Fairlight, Perreaux, Jands, JNS, Audiosound, Greencorp and others helping to provide a local presence.

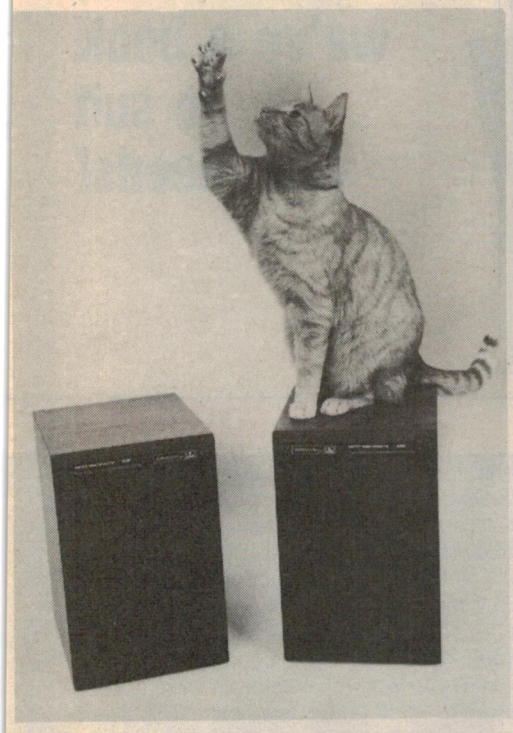
## Who needs it?

To the question of who needs all this equipment in Australia comes a variety of answers:

- Film, TV and associated production facilities are up-grading and expanding, both to meet the technical demands of the digital era and the insistent call for ever improved production capabilities.
- Television and AM radio stations are currently re-equipping for stereo sound, involving new audio equipment throughout plus, in many cases, modification to (or replacement of) transmitters and antennas.
- Anticipating an ultimate move to stereo, country radio stations, in particular, are looking also at



**You'd prefer a smaller console? Then what about the 16-channel Soundcraft Series 600 teamed with, say, an Otari deck — both from Klarion Enterprises?**



**Small monitors or a large cat? "A normal cat", says Ron Cooper, "but the speakers are Audiosound's 8024 Motet Mini Monitors"**



**Speakers ... speakers ... speakers ... including this group of Tannoys exhibited by the John Barry Group P/L. Also on show were the Tannoy "Titans", compact 2-way systems but rated at 100W.**

improved production facilities for local programs and advertising.

- Companies specialising in sound reinforcement systems for aditoria, public places and outdoor concerts are having to satisfy more exacting requirements.
- Musical groups are demanding cleaner sound, bigger sound, more effects ... and so on.

## Lecture program

As far as possible, the lecture and workshop sessions were grouped under the following general headings:

**Psychoacoustics:** Distortion, reverberation, sonic effects, intelligibility, and other factors affecting the listening experience.

**Instrumentation:** Sound pressure levels within an orchestra. New methods of measuring distortion, and of standardising line levels.

**Computers & Music:** A workshop presented by Fairlight Instruments.

**Audio production:** Special techniques required for motion pictures and for complex radio programs.

**Transducers:** Loudspeakers, enclosures, microphones and mic preamplifiers.

**The digital age:** Its demands in relation to equipment, tape, studios, mixing, time encoding, etc.

While it was most instructive to attend the above lectures and to look over the displays, the Convention also provided a golden opportunity, as mentioned earlier, to observe the reaction of delegates in matters of interest to EA readers.

## Other observations

One thing, plainly evident, was the huge store of goodwill that this magazine has built up over the years. I lost count of the number of people — educators, engineers, executives and representatives — who made a point of expressing gratitude for an initial introduction to electronics and for helpful back-up reading over the years. The 1983 series of articles on compact disc players came in for special comment.

Raymond Cooke also spoke warmly of "Electronics Australia" but added his further appreciation of the Australian

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# AES Melbourne convention

industry press as a whole: "It is far more responsible in its approach than some sections of the industry press in my own country," he said.

If there was one term that was taboo at the Convention, it was "HiFi". Even "High Fidelity" was used but rarely — in strong contrast to its prominence at consumer level shows. This was an *audio* convention, with the emphasis on the best possible quality of reproduction, expressed in sober facts and figures, not hyperbole!

HiFi? Tut, tut!

There was no real debate, that I was aware of, about the relative merits of analog and digital recording. It was simply accepted that, as one found it necessary to re-equip, digital was the appropriate way to go — if funds so permitted. Further, that the inherently low noise level and low distortion of digital recorders must be expected to make new demands of the associated equipment, and even of the studio itself.

Similarly, I was not aware of any debate about the merits or otherwise of compact discs. They were simply being accepted as the most "transparent" medium to date, substantially reflecting the characteristics and the quality of the original master recording. Indeed, there was a tendency to look somewhat askance at the use of black discs or analog tape, as a signal source for demonstrations.

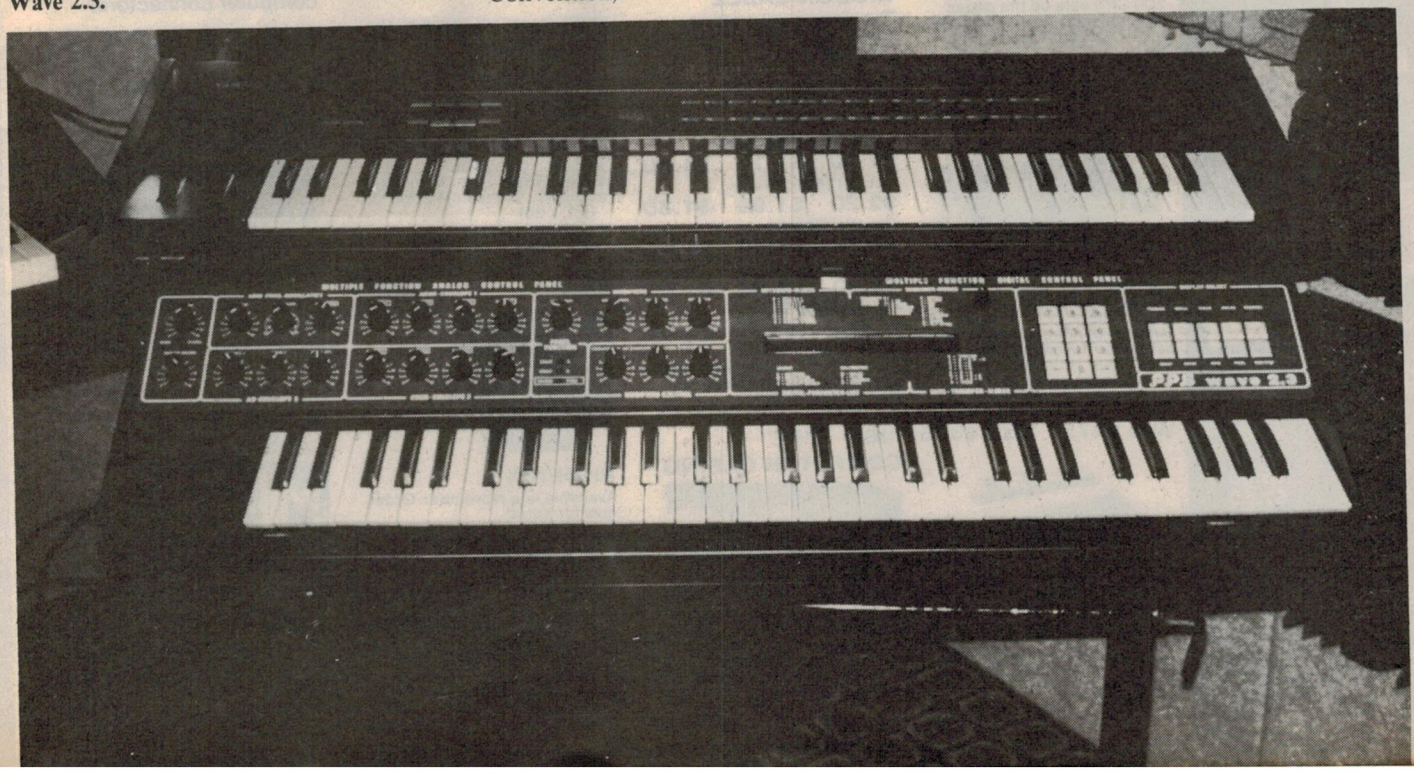
On quite another subject, I sensed considerable enthusiasm on the part of AM radio station engineers for the move to AM stereo broadcasting. They were quick to make the point that it would enable them to offer "dimensional" sound in cars, without the problems of multi-path distortion and "picket fence" reception that can plague FM.

(Sony's space diversity FM tuner, described in our last issue, could well restore the balance somewhat but not too many seemed to be aware of it at the Convention).

That aside, the engineers saw stereo as a development that might, at long last, induce receiver manufacturers to give proper attention to the design of AM tuners. It was commonplace, I was told, for the audio pass-band of AM receivers




**Greencorp Magnetics P/L were emphasising that their tapes are quality products, made in Australia. Greencorp now supplies only bulk industry orders but Opus or G-Tape branded lines are handled through Rainbow Products Ltd, 19 Rodborough Rd, Frenchs Forest, NSW 2086.**



**Keyboards were on show to delight the heart of any modern muso, including Yamaha's Wave 2.3.**

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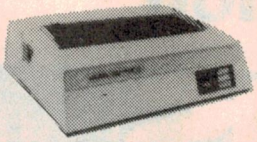
welcome here

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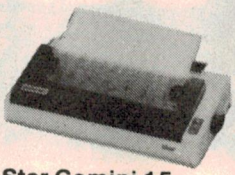
# PRINTERS GALORE



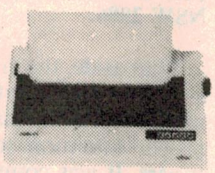
**Juki printer**
Professional daisy wheel printer 18 CPS full incremental mode Diablo 630 emulation
Large range of daisy wheels
8K internal buffer available.
**Was $950 Now $790**



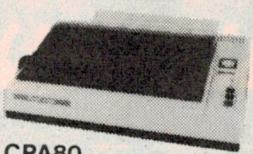
**Star Gemini 10**
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Friction and tractor
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Low cost typewriter ribbon
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**Star Gemini 15**
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Low cost typewriter ribbon.
**Was $899 Now $729**



**Star Radix 15**
Excellent fast printer
200 CPS eats up the pages
With an amazing 16K internal buffer you won't waste any time.
Has near letter quality mode, graphics, and font variation.
**$1,395**

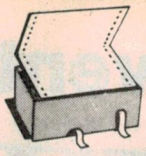


**CPA80**
The next generation of "80" type printers. 100 CPS, internal buffer expandable to 4K, Greek as well as italics. Dip switches accessible at the top. The print quality is the same as its forerunner. Square pins and film ribbon make it unbeatable.
**Was $475 Now $395**



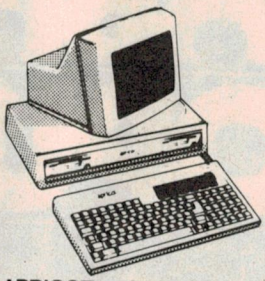
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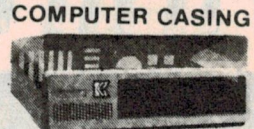
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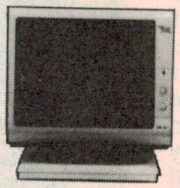
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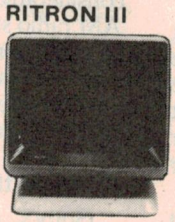
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Swivel base monitor in stylish case.

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|---|---|---|
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Great resolution, swivel base, Amber only. Prices include tax. Buy now for Xmas.

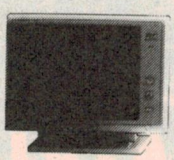
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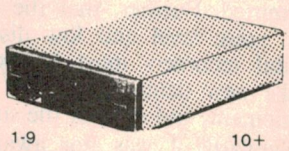
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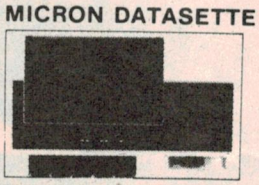
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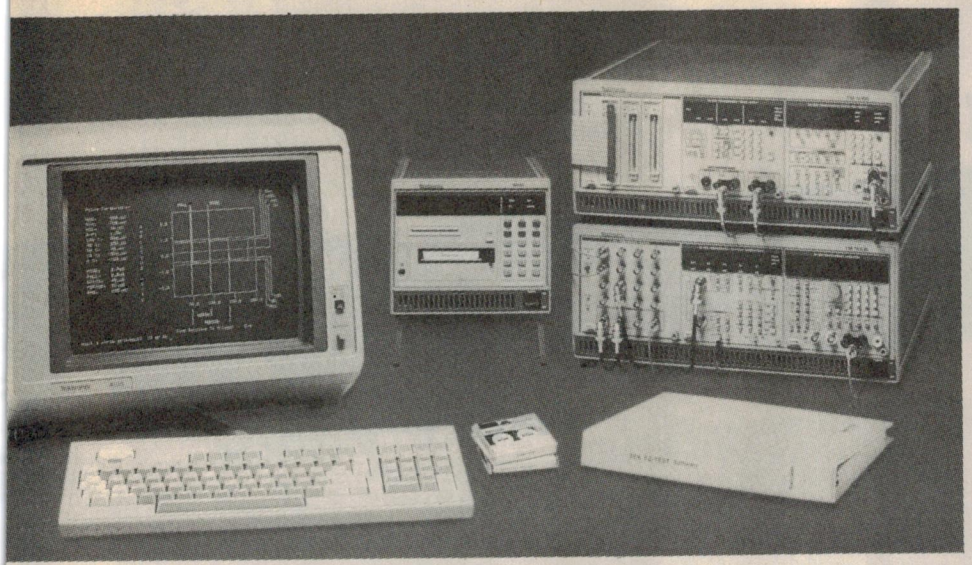



Brings out the best in any micro! Perfect for the Micron Datasette above!

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Cat. D11141

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**Tektronix were exhibiting programmable auromatic audio test equipment, including one typical operational set-up which ran through a sequence of response and distortion tests at the touch of a button. The printout shows frequencies, decibels and distortion levels to four decimal places!**

| FREQ. | Vs. | THD |
|---|---|---|
| 20.0 | | 0.0961 |
| 43.0887 | | 0.0951 |
| 92.8317 | | 0.0954 |
| 200.0 | | 0.0953 |
| 430.886 | | 0.0952 |
| 928.316 | | 0.0951 |
| 1999.99 | | 0.0951 |
| 4308.85 | | 0.095 |
| 9283.14 | | 0.0939 |
| 19999.9 | | 0.0902 |

to be several dB down at 2kHz, robbing the transmissions of intelligibility, let alone any sense of realism and sparkle.

If AM stereo is to work, and be capable of being demonstrated and sold to the public, receiver manufacturers will have to provide, not just a stereo decoding chip, but an adequate pass-band, adequate adjacent channel filtering and means to ensure accurate tuning — all technically quite feasible. Stereo or no stereo, say the engineers, tuners of that kind would bring a new sound to AM stations generally.

Incidentally, majority opinion around the convention seemed to be that the Motorola system would ultimately prevail in Australia.

## "Golden" Ears

I concluded my after-dinner address to the Convention by lamenting what I modestly described as the "highly debatable" claims made for over-size, or specially configured, or specially insulated, or specially non-insulated, or "directional", or even lead audio cables.

"Buy and fit these in place of normal cables," runs the message, "and you'll experience a whole new world of sound: better bass, treble, presence, placement ... better everything!"

"For most of this," I said, "I have yet to discover one shred of objective evidence.

"At this convention, there are many who combine educated ears with a high level of technical expertise. If you are convinced that supporters of the audio industry are being misled, or exploited in certain areas, the time may well have come for you to say so — out loud.

"If, on the other hand, my judgement is at fault, or I've missed out on some vital technical facts, I won't mind in the least being taken aside and shown where my thinking is astray."

As it turned out, I was taken aside several times, during the remainder of the conference, but only by people who shared my concern. There were plenty of gibes at the expense of the golden ear brigade but not one word of support that I heard for measures beyond the bounds of technical common sense. Said one loudspeaker distributor:

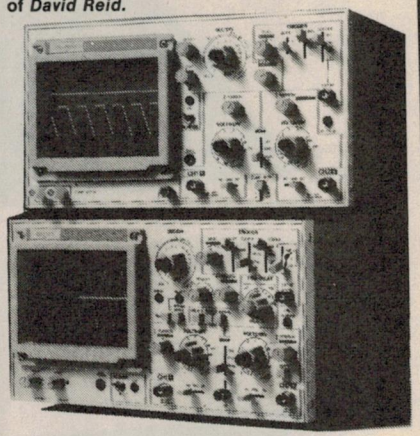
"You mentioned the risk of such modifications invalidating a manufacturer's warranty. What would you say about a loudspeaker system that had been 'rewired' with bits of cable so heavy that whoever did it couldn't solder it properly? So he twisted bits of thinner wire around the ends and soldered to those!"

As Charlie Brown used once to say: "Good grief!"

No, the "golden ear" brigade didn't fare too well at the Melbourne Convention! I waited in vain for somebody to explain the mysteries of what one of them described, last year, as hifi "crunge".


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***35 MHz 2-channel with Trigger Delay***
● Sensitivity: 5MV/div — 10V/div; 1mV/div at x5 MAG ● Bandwidth: DC or 10Hz — 35 MHz ● Sweep Mode: NORMAL, AUTO, SINGLE, DELAY ● Trigger Delay: INTEN'D, DELAY'D; 1*u*s — 100m S ● Trigger Source: INT, LINE, EXT, EXT/10 ● X-Y Operation; & X-Axis modulation

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**GPS-3030 DC POWER SUPPLY** **$193.00** **Provides 30V at 3A**

**GPS-3060 DC POWER SUPPLY** **$334.00** **Provides 30V at 6A**

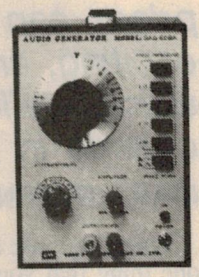
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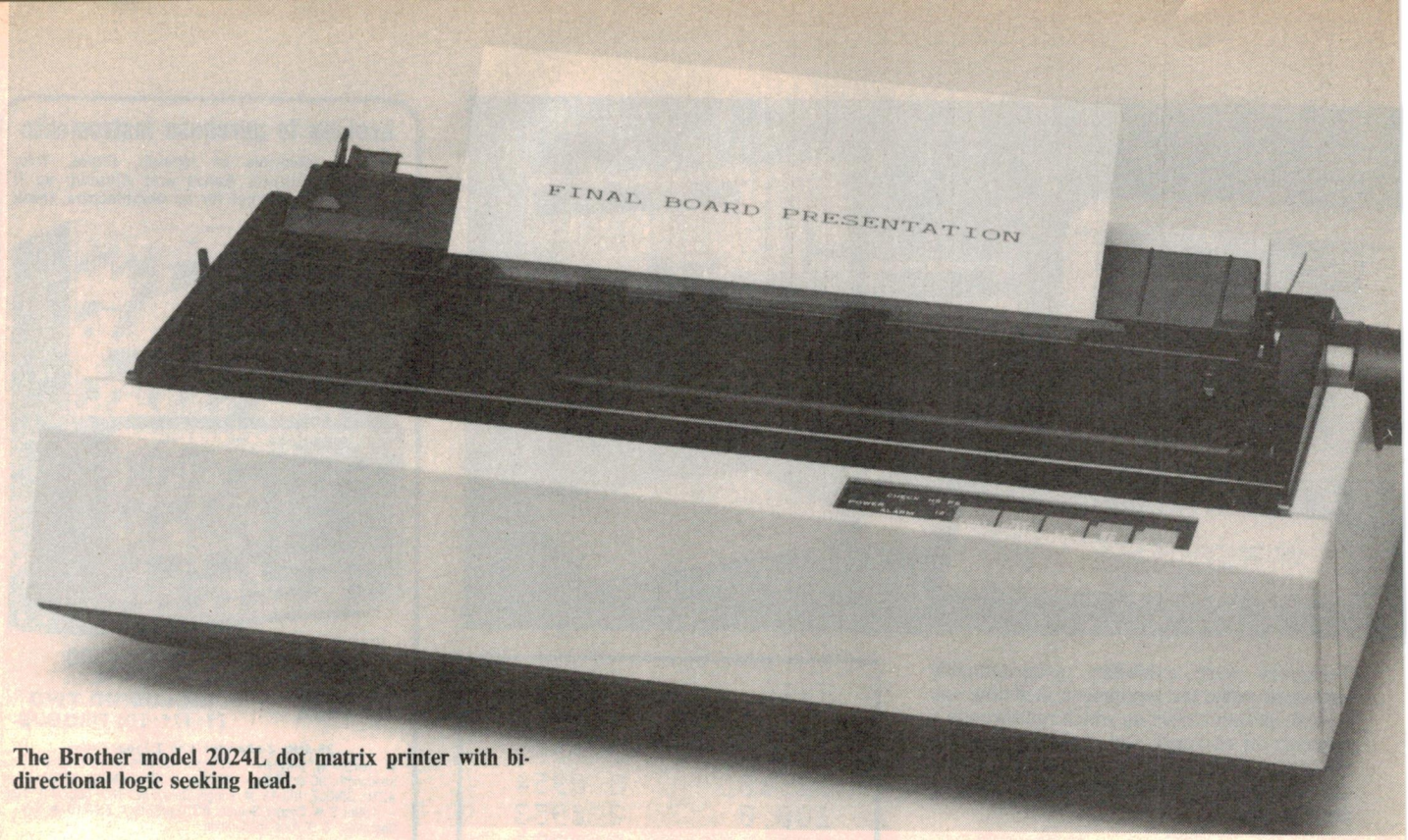


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**The Brother model 2024L dot matrix printer with bi-directional logic seeking head.**

# Printers
## -new technology, lower prices

*New technologies, new features, and falling prices can make shopping for a printer more exciting, and confusing, than ever before. In this article we'll show you what's new and what's coming in printers for your home and office.*

**MARC STERN**

When you talk about printers, there's one thing that you can be certain of — that is that the state-of-the-art is constantly changing. For instance, technologies that once cost thousands of dollars are now coming within the reach of the average home computerist. Also, conventional printers, such as dotmatrix and daisywheel types, are enjoying both improved performance and decreased cost.

In this article we are going to take a look at the current state-of-the-art in printers. Included will be both a look at what's new in such familiar printer technologies as thermal, dot-matrix, and daisywheel, and a look at some new technologies that are now, or may someday be, practical and affordable for the personal-computer owner.

### Ink-jet printers

Take the ink-jet printer, for instance. Only a few years ago, a sophisticated ink-jet printer's cost ranged from well over $2,500 to as much as $50,000. Today, those prices have dropped to as low as $895, with the most sophisticated units on the market running upwards of $30,000. What's more, today's ink-jet printers are capable of full-colour printing as well as graphics work.

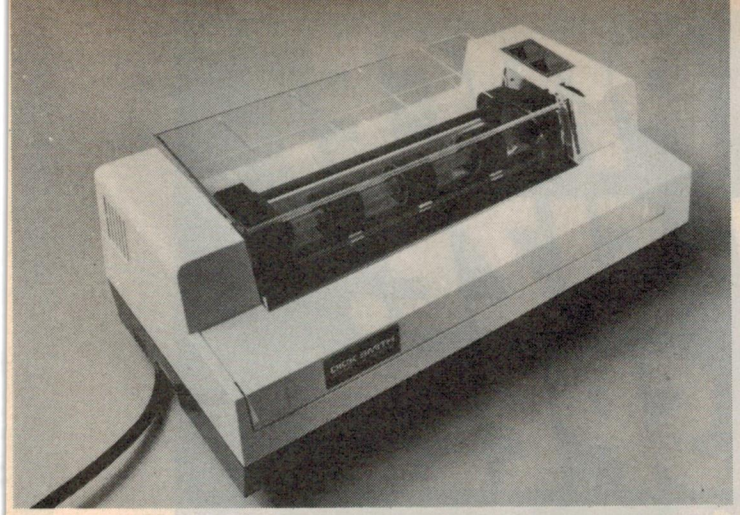
There are basically two main technologies used in ink-jet printing — continuous-stream and drop-on-demand. In continuous-stream printing, a constant stream of ink is ejected from a single channel and letters are formed by the movement of the printhead. As the ink is ejected, it is selectively charged using a pair of electrodes. The charged ink is applied to the paper, forming the output. The uncharged ink falls into a reservoir and is recycled through the printer, after passing through a filtering system. Continuous-stream technology is used in very sophisticated printers, that cost upwards of $30,000.

Drop-on-demand technology is far less expensive, and is finding increasing application in personal computer systems. Let's take a closer look at drop-on-demand ink-jet printers.

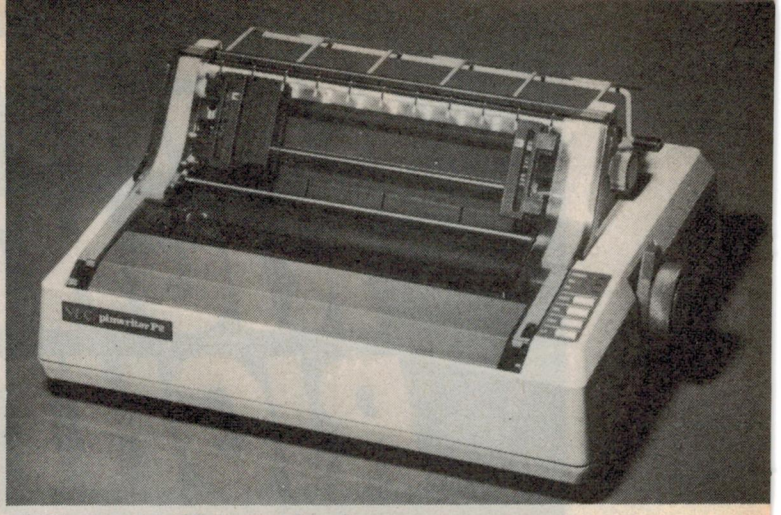
### Ink-jet basics

If you were to look at the output of a typical drop-on-demand ink-jet printer, you would probably wonder how the unit differs from a dot-matrix printer because the result looks much the same; ink dots are still used to form the characters. But, the technology used to produce those characters is radically different.

Unlike the dot-matrix (and daisywheel) impact printers that you might be familiar with, the drop-on-demand ink-jet printer is



Dick Smith's X-3250 features a uni-hammer head.



NEC's Pinwriter P2 dot matrix printer.

a non-impact type. An impact printer is any printer whose printhead element or a part of it actually strikes the paper, while a non-impact printer's printhead never does. For example, a dot-matrix printer has a tiny printhead filled with wires. Each one of those wires is controlled by the printer's logic circuitry and fires after it is activated by a small solenoid. The firing is controlled by the logic and the print produced is based on the character set contained within a special ROM in the printer.

Ink-jet machines also make use of a printhead and platen, but unlike impact printers, no part of the printhead in an ink-jet machine touches the paper. The result is that there is very little noise, one of the more common complaints about impact printers, whether they are dot-matrix or daisywheel.

Instead, tiny drops of ink are sprayed out of a series of nozzles and those are used to form the letters or graphics of the final output. Either a low-pressure area or special electrostatic circuitry is used to form the characters after the ink is fired at the paper. The nozzles are connected to a series of ink-filled channels, which are linked to an ink cartridge, which supplies the ink for the printing process.

## A closer look

If you were to look at the printhead of a drop-on-demand printer, you would see a series of nozzles; the number and pattern of nozzles will vary from machine to machine. Those nozzles are connected to the ink channels. A piezoelectric crystal tube in each channel is stimulated by an electrical pulse, causing the crystal to expand slightly and this increases the pressure inside the channel. In turn, the increased pressure pushes the ink away from the crystal and towards the nozzle, where a tiny ink droplet forms.

As the pressure is decreased when the crystal contracts, the droplet breaks away from the ink stream and is, in turn, deposited on the surface of the paper. Like the dot-matrix type printers, the dots are arrange in a pattern that forms the letter.

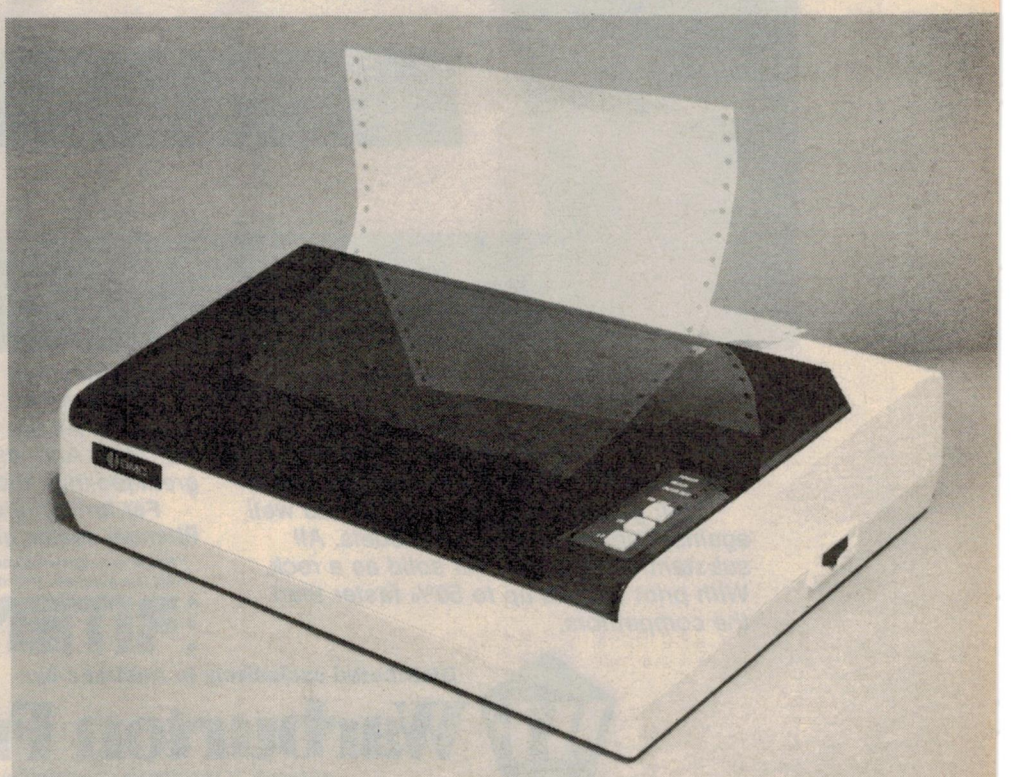
To keep the ink from being deposited where it isn't supposed to be, the ink-jet uses a slight negative pressure to keep the ink inside the channel when that particular jet nozzle isn't being used. Thus, if you were to look at a cutaway of the print head, you would see a slightly concave indentation in the surface of the ink.

## Ink-jet advantages

An ink-jet printer has several advantages over a dot-matrix or a daisywheel impact printer and the first is the noise level. Quite typically, the ink-jet printer is a fairly quiet machine, one which will fit in well with a home computer setup. Its noise level contrasts quite markedly with the rat-tat-tat of the daisywheel machine or the loud whirring of the dot-matrix printer.

Another advantage is low maintenance cost. Since there are few moving parts in the typical ink-jet printer, its maintenance requirements are very low. Further, because the printhead never touches the paper, it isn't degraded as are those of impact machines. Thus, its life can be much longer. The life of the typical ink-jet printhead is in the vicinity of 10-billion characters, as opposed to about 200-million for the average sophisticated dot-matrix printhead. And, because the ink-jet machine doesn't depend on a ribbon that is subject to wear, the print quality remains constant over time.

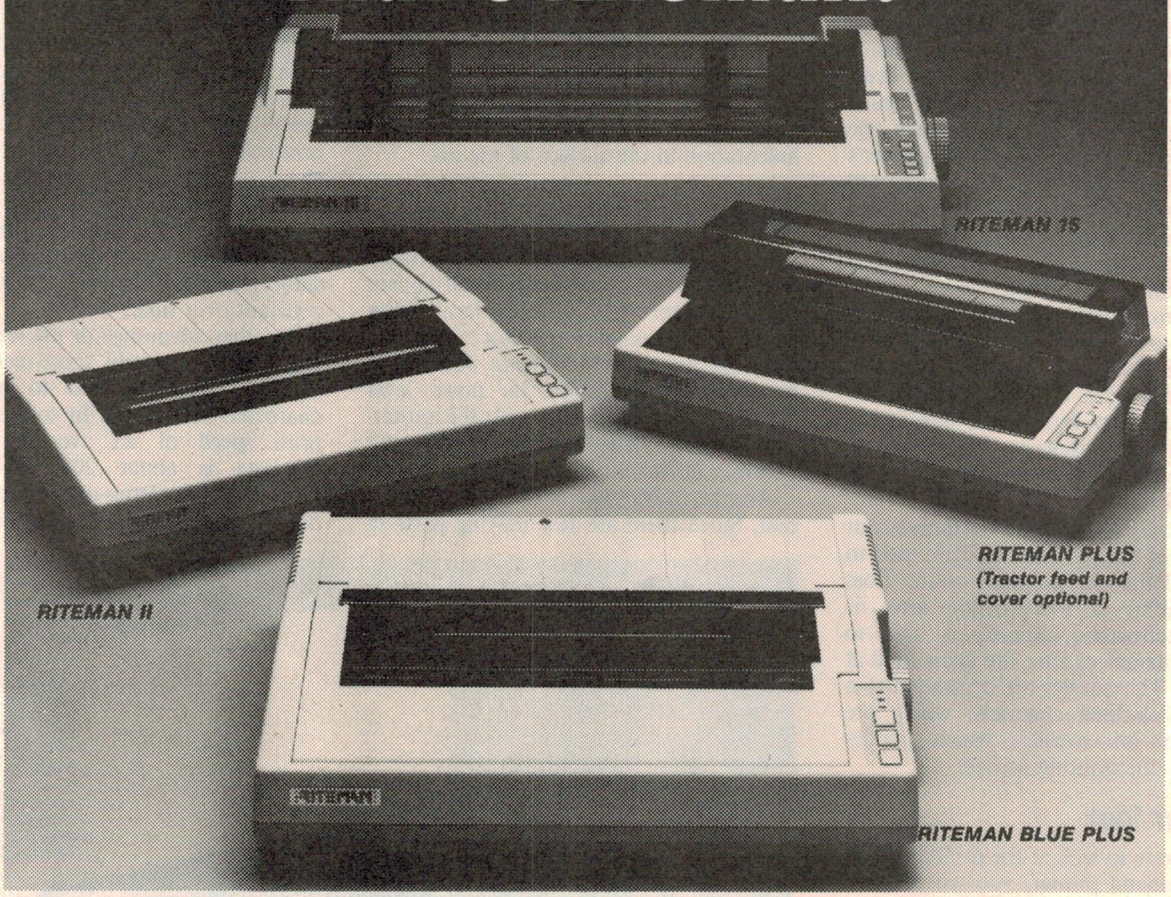
Another advantage of ink-jet printers is speed. Quite typically, those machines race along at between 150 to nearly 300 characters-per-second. In contrast, the top print speed of an average dot-matrix machine is about 200 characters-per-second. Most letter-quality printers — daisywheel printers — run from 12 to 40



The BX-80 bi-directional dot matrix printer is available from Dick Smith Electronics.

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characters-per-second.

The primary disadvantage of a drop-on-demand ink-jet printer lies in its inability to produce more than one copy at a time and in the fact that its output still looks like a "computer" printout — the dots in its matrix are quite evident. Further, top-quality print runs require special absorbent papers, although bond paper does the job adequately.

## Graphics capability

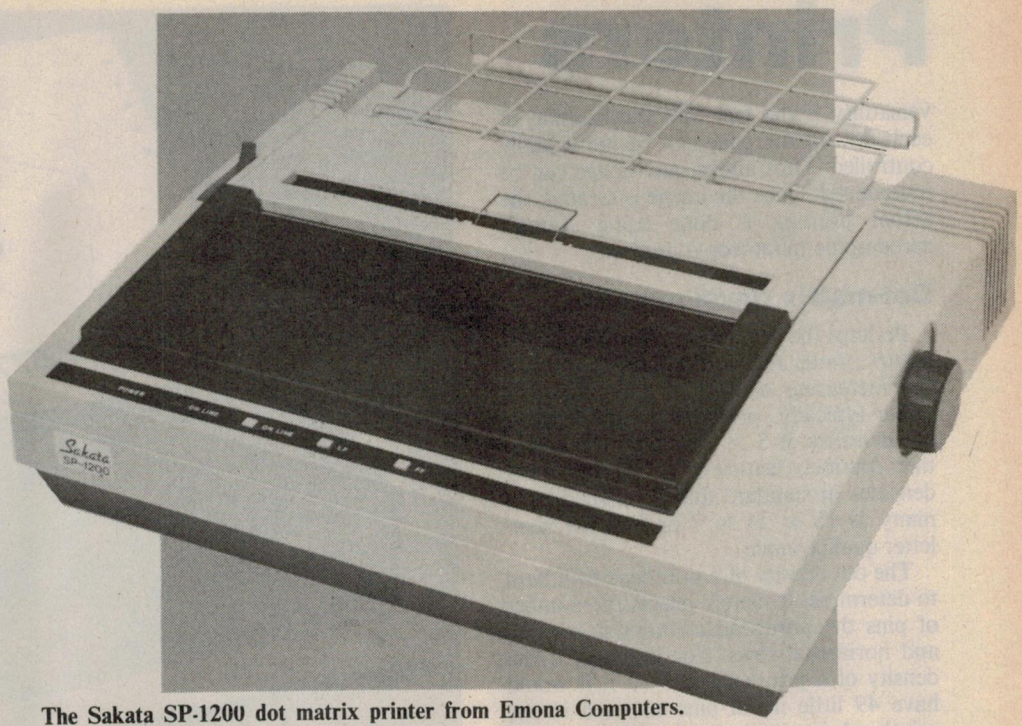
One of the beauties of the ink-jet printer is its graphics capability. Because of their precise tracking capability and because they are not limited to using dot-matrix impact pins, the ink-jet printer is capable of very highly detailed graphics. That means you can produce some highly complex graphics with subtle variations of grey, black, and white.

Another area where the ink-jet printer shines is in colour-graphics printing. Although dot-matrix printers are capable of colour printing, they have some drawbacks. Since they are limited to the use of multi-coloured ribbons, dot-matrix machines take a longer time to produce a colour output. Each colour or colour combination requires a different pass of the printhead and that slows things down more than just a little bit. Also, since the separate dots never completely line up, it is possible that there will be gaps in the final printout and solid areas may end up incompletely filled. Finally, since dot-matrix machines must rely on ribbons and since ribbons tend to wear out fairly quickly, outputs produced later in the ribbon's lifetime will be lighter than those produced earlier.

In contrast, a colour ink-jet printer uses a special four-colour ink cartridge and applies the colours, or combinations of colour, when called upon by the graphics programming in the microcomputer. Since it is capable of multi-colour output, the time needed to create the final output is shortened considerably. Further, solid colour areas appear much more uniform in density because it is possible to overlap the ink dots. Also, since it is possible to mix the colours directly on the printout, the ink-jet printer is capable of printing many more colour combinations and hues than a dot-matrix machine.

Because the printhead of the ink-jet machine is microprocessor-controlled, it is possible to have the printhead dither. When the printhead dithers, it mixes the ink droplets in different intensities, thus creating darker or lighter colour intensities.

In general, you will find that the cost of ink-jet printers has fallen markedly during the last year, as have the prices of just about all computer printers. Roughly a year ago, it wasn't uncommon for a good reasonable-cost ink-jet printer to cost between $2500 and $6000, with some of the top-quality machines costing up to $50,000. Now, the cost of a good ink-jet printer is approaching that of some of the more capable dot-matrix machines on the market, about $895. Even top-quality machines have had price drops, too, to the $30,000 region. As for a good colour ink-jet printer, you'll still have to wait some time until the prices drop even further. Even though their prices have dipped in the recent months, you'll still find them expensive pieces of equipment, ranging in price from $5500 to nearly $12,000.



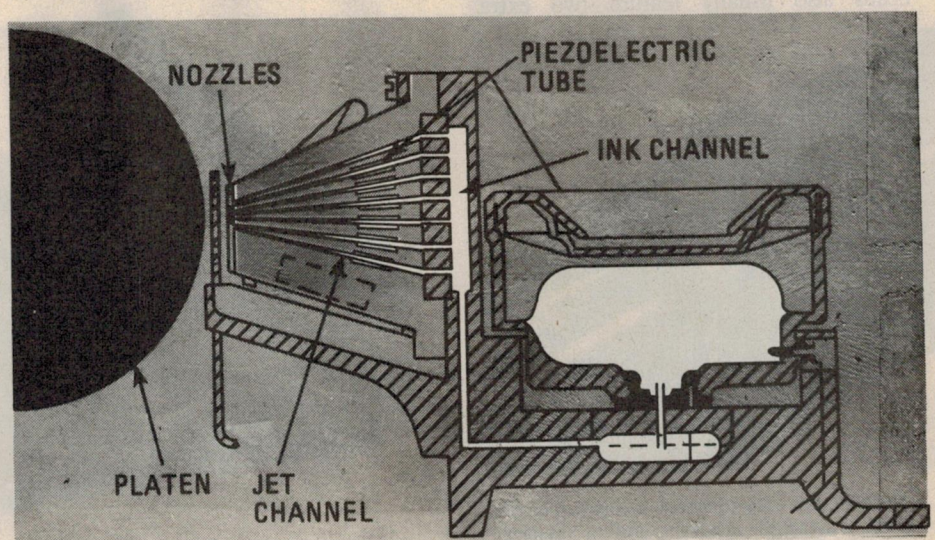

**The Sakata SP-1200 dot matrix printer from Emona Computers.**

## Laser printing

Although their cost puts them beyond the means of most personal computer owners, if you own a large business, or have need of offset-printer-quality output, you may be interested in some of the laser printers currently on the market.

One such machine is the Xerox (Printing Systems Division, 880 Apollo Street, El Segundo, CA 90245) 5700. That system can produce documents in a wide variety of type styles (up to 256 can be stored), and in type sizes ranging from 6 to 24 points. Graphics can also be accommodated. Printing can be done on both sides of a page, plain paper is used, and up to 43 pages a minute can be produced.

The key to the printer is a laser-imaging system. That imaging system has a resolution of up to 90,000 dots-per-square-inch, which is why the system can produce copy that compares favourably with offset printing. The key to the machine's




**An ink-jet printhead. This diagram shows the key parts in a drop-on-demand system.**

# Printers

versatility is the fact that the location of each dot on the page can be individually controlled. Thus almost any image can be reproduced. Once the image is created, the actual printing is done using Xerox's xerographic (photocopy) process.

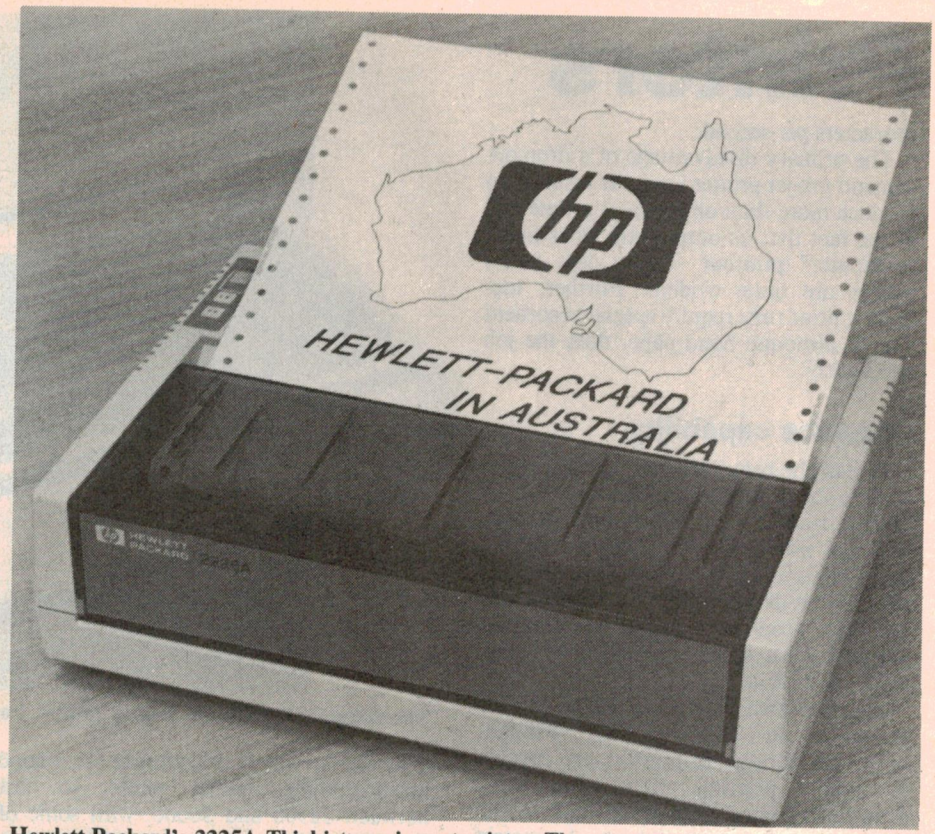
## Dot-matrix developments

Perhaps the key development in the dot-matrix printer realm during the last year is the increasing density of the printhead. Quite typically, printheads used to have dot densities of 5 × 7 or 7 × 7 and now they routinely feature 9 × 7 or 9 × 9 dot densities in standard (draft) mode, and as many as 18 or 24 × 7 or 9 in the near-letter-quality mode.

The dot density of a printhead isn't hard to determine. It merely means the number of pins the printhead contains in vertical and horizontal rows. For instance, if the density of a printhead is 7 × 7, it would have 49 little metal pins enclosed in the printhead in seven horizontal rows and seven vertical rows. If the density is 9 × 7, then there are nine vertical rows and seven horizontal ones.

The biggest criticism of the dot-matrix printer in the past has been its "computerish" hardcopy output. That means that the printout is made up of very noticeable dots, no true descenders, and is very hard to read. However, that criticism has been nullified by the near-letter-quality output of some dot-matrix printers.

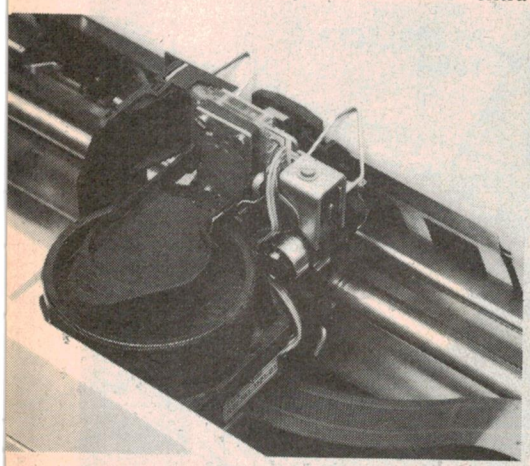
Using overlapping vertical rows of pins, those printers actually lay down two slightly offset dots during its print run. Those dots give the hard-copy a more "typed" look when it is printed. The dot-matrix manufacturers are able to achieve this thanks to the fact that they are using printheads with finer wires, which permits greater density (18 or 24 × 9). Since those heads also usually feature two extra horizontal rows of pins, they are also capable of having true descenders on such letters as "g" or "y".

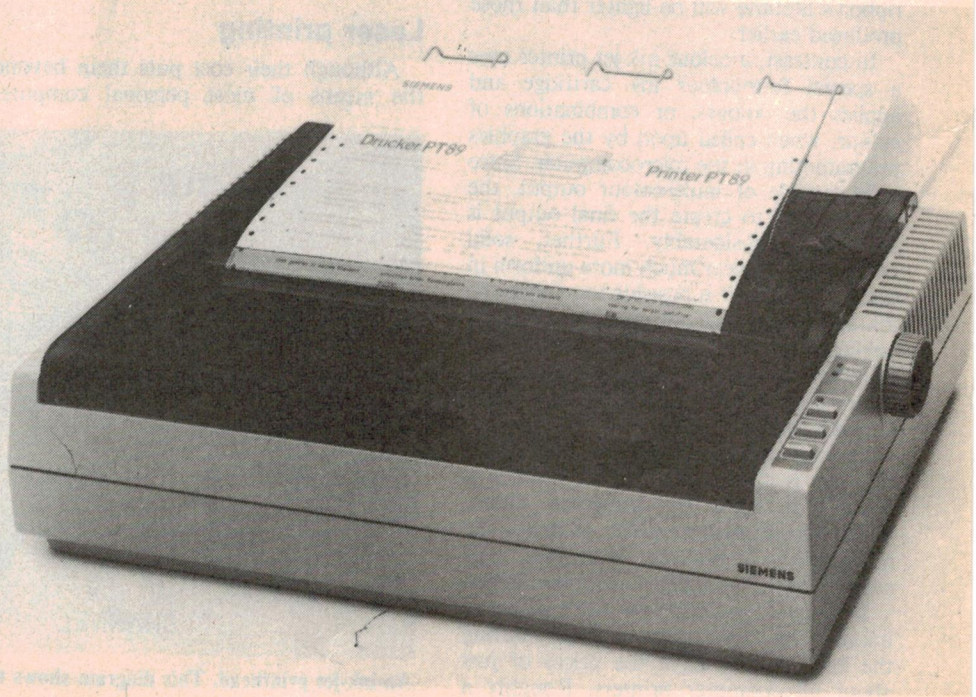



**Hewlett-Packard's 2225A Thinkjet non-impact printer. The system is clean, fast and quiet.**

At one time — about a year-and-a-half ago, that type of output was available only on machines costing more than $1,200, but now it is available on dot-matrix printers costing around $500. And, even low-cost printers — $199 to $499 — have printhead densities of 7 × 7 or 9 × 7, so that their output has a more professional quality.

One problem with the new near-letter-quality dot-matrix printers is that they take away one of the dot-matrix printer's biggest advantages — speed. That's because generating the slightly offset dots needed to produce the nicer looking output requires that each letter be actually printed twice, slowing down the entire process. But printer manufacturers have found a way to






**The Siemens inkjet printer: a close-up of the print cartridge (above); and a general overview (right).**

# 利心

## "Ask not what your printer can do but only what it can do for you"

New Japanese Proverb.

The razzle-dazzle and the hype continues. Computer salesmen fall over each other trying to sell you the latest, very expensive add-ons ... those elaborate bits 'n' pieces that will convert your humble desktop computer into an electronic marvel.

That's nice if what you need is a racehorse. But what happens if what you really need is a workhorse? The computer tasks in your office may be quite specific and unlikely to change. A damn good workhorse add-on may be all that is required.

A printer, for example, is likely to be the very first addition to your desktop computer.

But here's the problem. A printer can cost you from $1,000 to $5,000. How then do you choose the one you need? If you're wise, you choose your printer for what *you do* and not for what *it does*.

**THE TOSHIBA P 1340 – THE PRINTER WORKHORSE.**

The new Toshiba P 1340 starts with the distinction of being the only printer that has been specifically designed for the personal or desktop computer.

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**SPEED – HOW ESSENTIAL?**

Everything in life is a compromise of sorts. If you want brilliant type resolution then you're going to have to sacrifice speed.

The very best type resolution only gives you 13 characters per second. By printer standards that's pretty slow, about the speed of a competent typist. The P 1340 gives you 54 characters per second for letter quality printing and 144 characters per second for internal memo or normal office print-out material. You can get a more expensive printer that does it twice as fast but you sacrifice clarity. The general rule is that speed costs you clarity. The P 1340 is thought to be the perfect compromise.

**WHERE THE P 1340 SHINES.**

Many computer sales outlets privately conclude that the Toshiba P 1340 is destined to be the premier dot matrix printer for personal computers.

It is, after all, the perfect compromise between clarity and speed at an attractive price.




The Toshiba P 1340 is ideally suited for word processing as it has a clarity that rivals a daisy wheel printer but is up to 75% faster. It comes with Qume SPRINT 5 emulation, standard friction feed and true proportional spacing for letters.

It is also ideal for data processing and has a built-in pin feed tractor for continuous forms. It handles papers from 11.2 cm to 25.4 cm wide.

**P 1340 – PART OF THE TOSHIBA PRINTER FAMILY.**

Toshiba have three printers – the P 1340, P 1350 and P 1351. The other two have more sophisticated applications and therefore a bigger price tag.

But you shouldn't let that influence you.

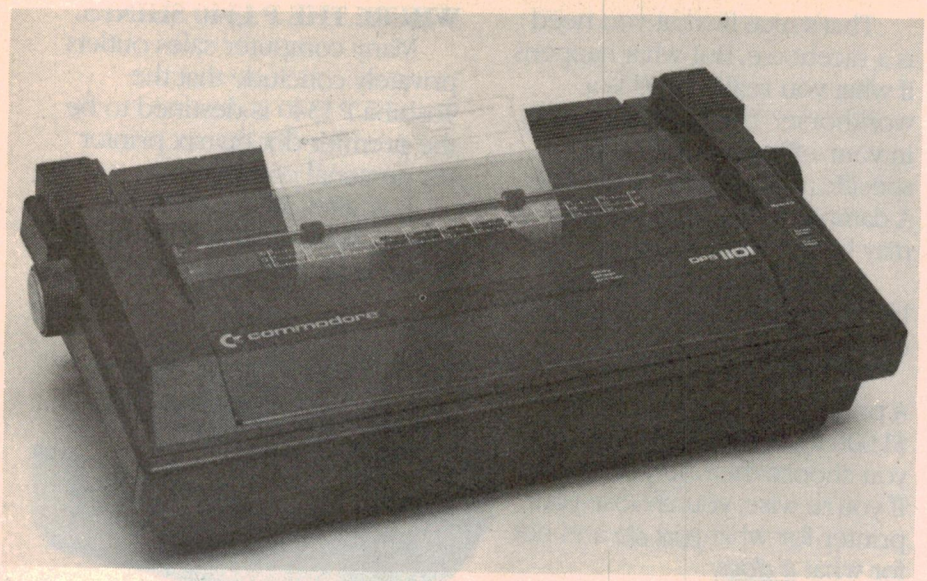
The P 1340 may be exactly what you need. If it is, then it is exactly what you should get.

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**The DPS 1101 — Commodore's new unidirectional daisy-wheel printer.**

# Printers

let us "have our cake and eat it, too." That is, all but the least expensive dot-matrix machines these days are dual-mode. They offer a high-quality but slow near-letter-quality mode as well as a less attractive looking, but much faster draft mode. Typically, the print speeds on those machines vary from 40 to 80 characters-per-second in the near-letter-quality mode and from 160 to 200 characters and more in the draft mode.

## Dot-matrix printheads

Let's look at the typical printhead. A dot-matrix printer is called an impact printer with good reason. Its printhead contains fine wires that are fired electrically into a ribbon, which strikes a piece of paper, thus producing the image.

The firing of the pins is controlled by solenoids that are activated by electrical pulses received from the character-generation ROM. That ROM contains the ASCII code for the characters and the pins corresponding to that code are all fired at the same time to produce the required letter.

As are ink-jet machines, dot-matrix printers are almost universally bidirectional printing units — they print on both passes across the paper — and they usually feature logic-seeking printheads. Logic-seeking printheads seek the shortest path between two printing points thus cutting printing time. Because they are logic-seeking and microprocessor-controlled, dot-matrix printheads are usually capable of graphics output. Typically, most of them have a special programmable graphics mode that is capable of laying down nearly 80 × 80 dots-per-inch, and, even more if special graphics software is used.

Since there are few moving parts in a dot-matrix printer, other than the linefeed motor and motor used to move the printhead, those units tend to be fairly reliable. Printheads last a long time, on the order of 200 million characters, although that isn't as long as a typical ink-jet printer.

The biggest drawbacks of dot-matrix printers are their noise and the fact that ribbons wear out fairly quickly. Most dot-matrix machines emit noise in the 65- to 85dB range, which makes them rather uncomfortable to be near for any length of time. Newer machines, however, tend to be a little quieter.

Dot-matrix machines also seem to run through ribbons very quickly, especially if they are used a great deal. That means that early printouts are good quality, but later printouts tend to be lighter and harder to read. And, if those ribbons aren't used quickly, they tend to dry out and also produce lighter printouts.

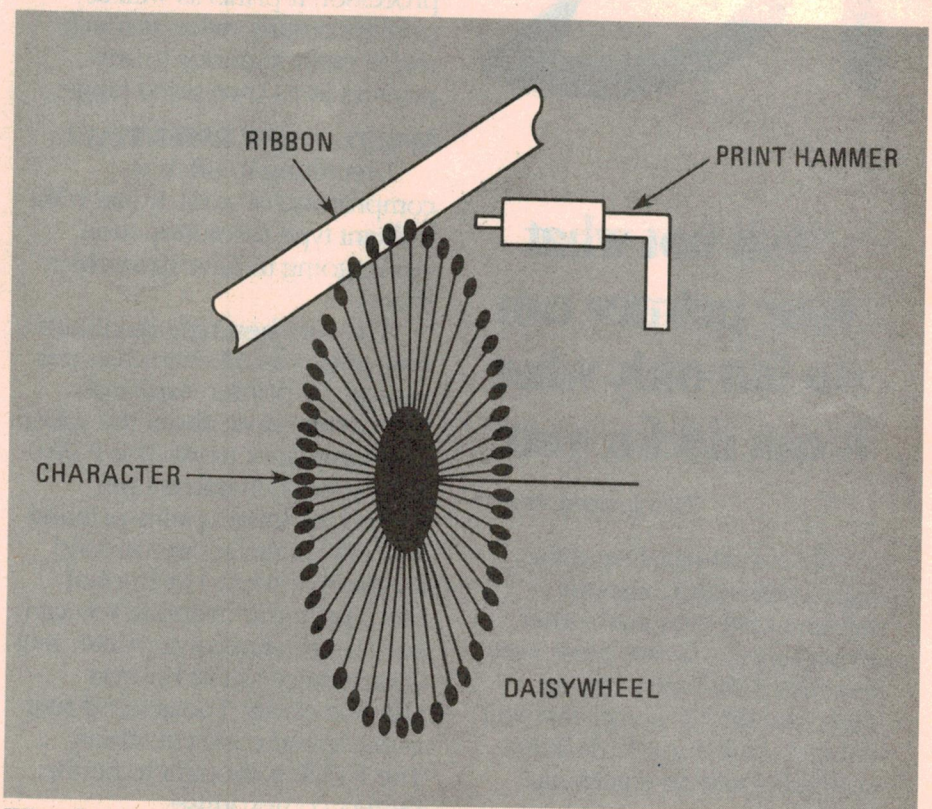
## Daisywheel developments

The other type of impact printer on the market is the letter-quality or daisywheel printer and its variant, the thimble printer. Both rely on essentially the same technology, but, during the last year, their capabilities have been increased markedly.

At one time, the average low-cost daisywheel printer was a unidirectional, noisy, slow-speed affair. It did produce top-quality printing, but the tradeoff was that it took forever to complete a printout. Those units tended to operate very slowly — 12 to 18 characters-per-second — tying up the computer for long periods as they slowly worked their way through documents. If you wanted high-speed, bi-directionally, and microprocessor control in your daisywheel, you had to spend nearly $3,000.

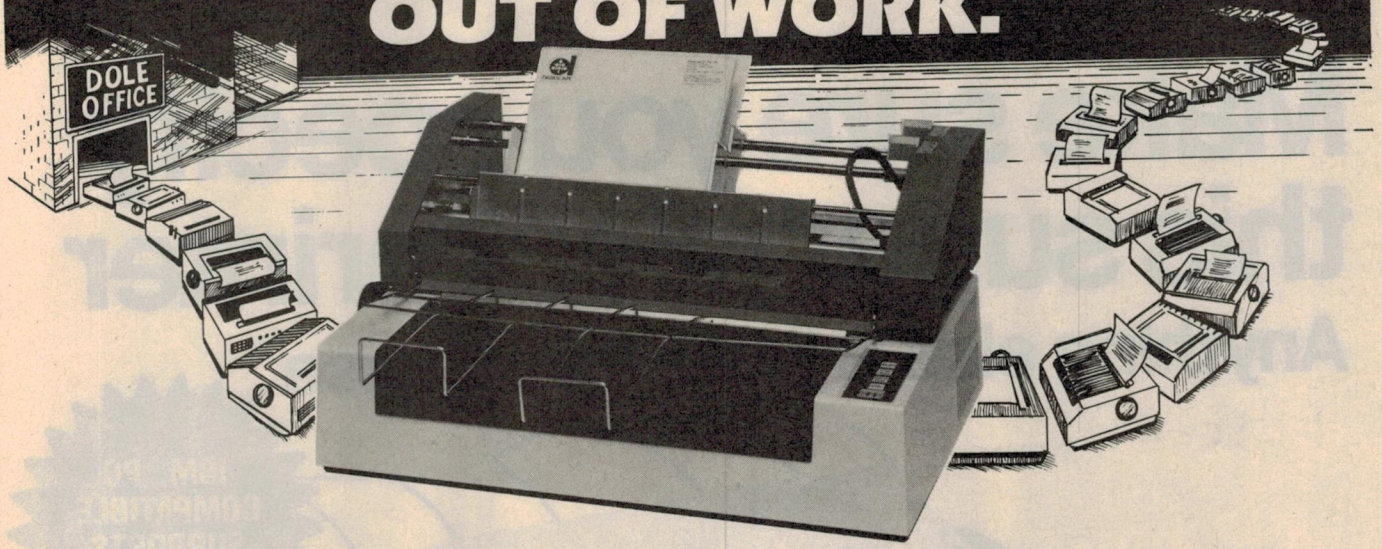
But, the last year or so has seen a change in this, beginning with bidirectional daisywheel printers for personal computer use now available for less than $800.

The key to the change in the daisywheel market was the introduction of microprocessors in those devices. That development allowed low-cost daisywheel printers to gain bidirectionality and logic-




**When the hammer strikes a daisywheel "petal", the character on the petal is printed.**

# THE NDK 5025. PUTTING OTHER PRINTERS OUT OF WORK.




**You may not have realised it, but there is a quiet revolution going on in printers.**

Users of mini, micro's, PC's etc. have, until recently, been forced to buy unique printers for their differing applications; a daisy wheel for word processing, a high speed dot matrix for EDP and, perhaps, a specialised printer for graphics.

Now, one type of printer can do the lot!

They are known as multimode dot matrix printers. And, of these, the NDK 5025 leads the field.

## But, will it work with my system and do all my work?

Firstly, the NDK 5025 copies or emulates several well-known printers, enabling you to use it with your existing software. For word processing it looks like, and does everything that the popular Qume Sprint 5 daisy wheel can do. But at 90 cps – nearly three times as fast! For draft work it "burns along" at 180 cps. If you are using an IBM-PC then, with the flick of a switch, your NDK 5025 will emulate the standard IBM dot matrix printer. But, again, at much higher speed and quality. If you're into graphics such as Lotus 1-2-3, the NDK 5025 will emulate either IBM, Epson or Toshiba P1351.

## What's its print quality like?

The NDK 5025 uses a 24 pin head to form the characters, which look as good as a daisy wheel! It also has built-in fonts (just like changing daisy wheels) including Courier 10, Prestige 12, Bold P.S., Draft, Italic, Sub Super Script, Compressed and Scientific. Special customer generated fonts can be down-loaded, too.

## Is it flexible?

The NDK 5025 is a full-width printer with friction roller and tractor as standard. A dual bin sheet feeder and cut sheet guide are available as options to make your printing life easier.

If you are still not convinced, look at the names behind the printer. NDK is a famous Japanese company specialising in the high quality end of the printer market – more than 3500 units are installed throughout this country – while Datascape is Australia's leading independent specialised printer company with a nation-wide support system.

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# Printers

seeking capability. It also enables the daisywheel to be used for something that was once the province of the dot-matrix printer — graphics. Because the printhead can now be controlled with computer precision, the low-cost daisywheel printer can be programmed for a minimal level of graphics. It can produce such things as charts, graphs, and some limited pictorial matter.

Let's take a look at a daisywheel printhead. Where a dot-matrix machine uses solenoids and pins, the daisywheel uses a whirling disk with flexible petals, and a small hammer. Each letter is fully formed on a petal of the printwheel, which somewhat resembles a daisy; it's from the printwheel that the machine gets it name.

As the printhead moves across the page, it receives the ASCII codes output from the character-generation ROM. However, instead of those pulses activating a series of wires, they cause the whirling disk to align the appropriate letter-petal with the ribbon. The petal is then struck by the hammer, which produces the letter.

The key drawbacks of this machine, again, involve noise and speed. Even at their quickest, they are only about one-quarter to one-half as fast as the slowest dot-matrix machines on the market. But, the quality of the print they produce, since the letters are fully formed, can't be topped. Also, those printers give you the capability of changing typefaces or type sizes easily as the daisywheels themselves can be changed.

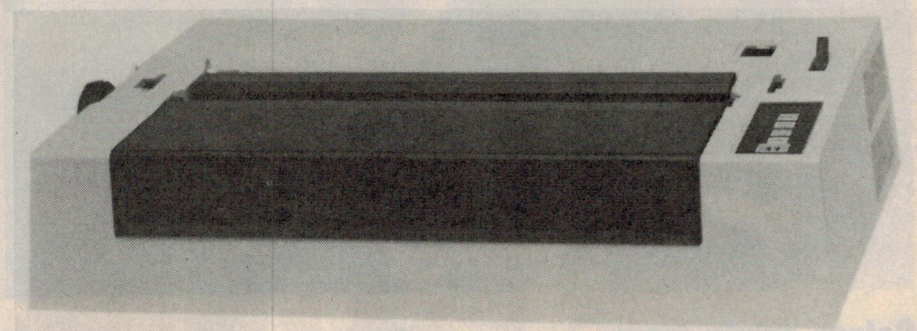
A variation of the daisywheel printer is the thimble printer. In those machines, rather than a daisywheel, the print element resembles an upside-down thimble with spokes. As with the daisywheel, each of the spokes contains a fully formed letter.

## Thermal printers

Thermal printers are dot-matrix devices. However, rather than using ink to do the printing, they use special heat-sensitive paper and pass it over a series of heated pins to create the print out. Thermal printers have always been among the least expensive devices on the market, but have suffered from the fact that the required paper is expensive and their output is often of poor quality. On the plus side, those printers are fairly fast.

The picture for thermal printers has gotten much better of late. For one thing, many of the new machines are capable of using plain paper. What's more, thermal printers capable of multi-colour output have now reached the market. Those use plain paper and heat-sensitive dye. The paper is drawn over a heater bar after the dyes are laid down creating the image. The result is a fairly inexpensive colour printer.

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**The NDK multimode printer. It can produce a wide range of printer styles.**


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IBM reg trade mark of International Business Machines Corp. Apple reg trade mark of Apple Computers Inc. EMTEK reg trade mark of Emona Computers Pty Ltd. MICROPROFESSOR — Trademark of Multitech Industrial Corp.




## Colour prints from computer graphics

Polaroid has introduced a new system for producing high-quality instant 35mm slides and instant prints of personal computer graphics.

Called the Polaroid Palette computer image recorder, the new system is a software-driven peripheral which connects via an RS232C communications line. It is compatible with IBM-PC, IBM PC/XT, Apple IIe, Apple II+, Compaq, Digital Rainbow and Franklin Ace 1200 personal computers.

The Palette image is created by means of a 75mm monochrome monitor. The film is exposed through a rotating filter wheel, which can additively create any colour by multiple exposure of the film. For multi-coloured images, successive exposures use a different part of the original image.

The computer and software match exposure parameters to whatever film is being used, either Polaroid instant print or slide film, or a range of conventional 35mm films, while allowing the user to control colour selection and location. Special colour keys permit selection of as many as 16 colours for a single image.

This system can be used to generate colour hard copy for presentation from an original monochrome image.

In Australia, the Palette system will sell at $2200, excluding tax. This includes the exposure unit, software diskette, cable connections, a 35mm auto-advance camera back, the 35mm Autoprocess instant slide hardware, some film and slide mounts, a Polaroid camera pack for Polacolor 83 x 108mm prints, instruction/tutorial manual and a service agreement.

For more information: Polaroid Australia, Eden Park Estate, 31 Waterloo Road, North Ryde, NSW 2113. Phone (02) 887 2333.

## Computer/printer switching units

The advent of modern day offices with many computers can create the problem of how to conveniently connect a particular computer to a particular printer in order to provide the standard or style of printout required.

Cable-Tectonics, manufacturers of cable assemblies for interfacing computers and printers, are often asked how to solve this problem and in consequence have designed a complete range of printer switch units which will provide the unskilled operator with the means to quickly and easily select the required printer.

Six different models, all designed and manufactured in Australia, are available for the electronic office. For example, a unit is available for the office that has two individual microcomputers and three printers capable of (a) letter quality, (b) graphic printing and (c) general applications such as accounting functions. Using these printer switch units eliminates the need to unplug and re-plug cables manually which can not only be tedious, but can cause interconnect problems that could lose data.

Further information from Cable-Tectonics Pty Ltd, PO Box 126, Brookvale, 2100. Telephone (02) 938 5211. Telex 70011.




## Line conditioner for computers

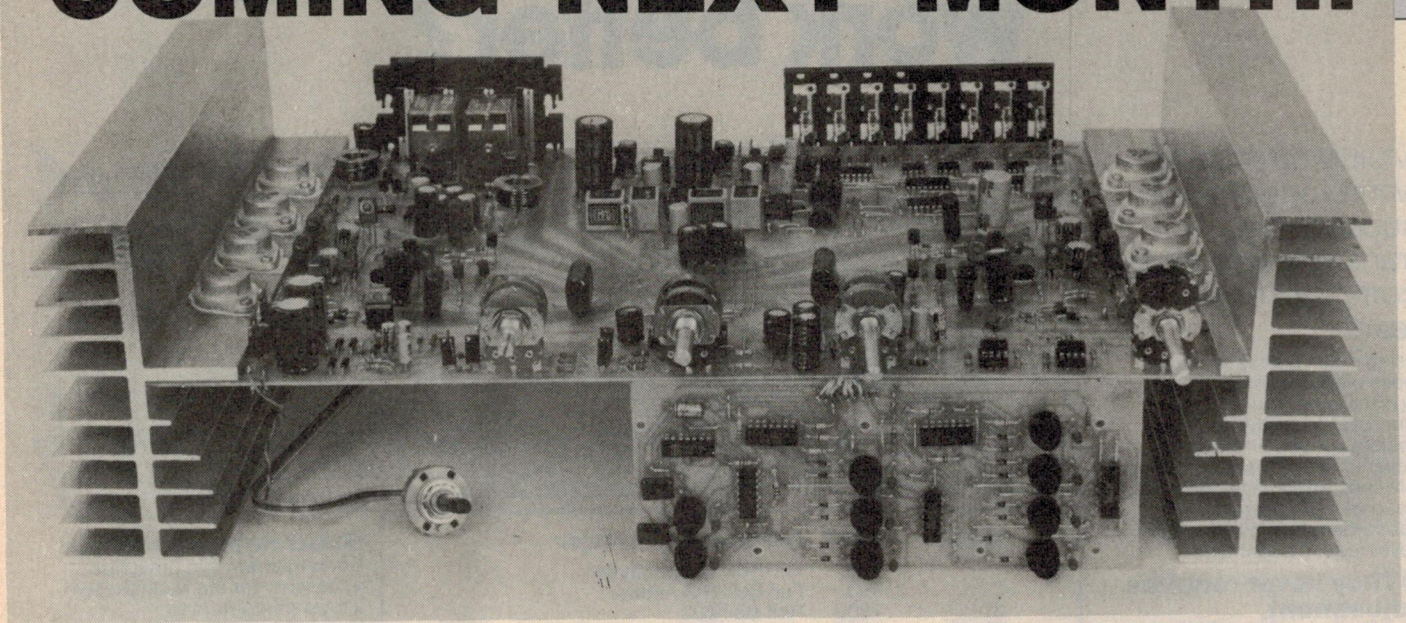
Advance Electronics UK (formerly Gould Advance) has released a new mains conditioner, the WPC 150, specifically designed for use with small computer systems.

In addition to its voltage regulation properties the WPC 150 attenuates mains borne transients by over 50dB. It is mains voltage transients, more so than slow changes in the RMS mains voltage level, that cause most problems in computer systems. For a worst case situation of simultaneous 100% load change and line voltage change from 190 to 260VAC, the WPC maintains a sinewave output voltage of within 6% of 240VAC.

The WPC 150 is rated at 150VA which is adequate for most small business and home computer applications. Higher powered units to 6kVA and above are available for larger systems.

Further information from A. J. Distributors Pty Ltd, PO Box 71, Prospect SA 5082. Phone (08) 269 1244.

# COMING NEXT MONTH:



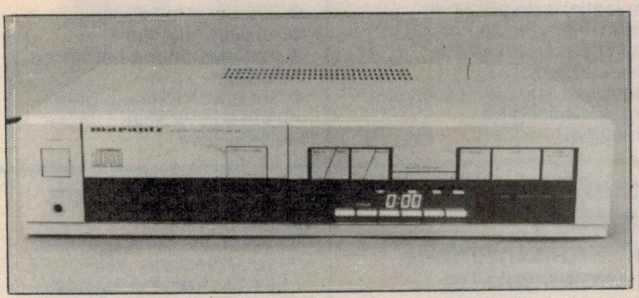
# The best integrated amplifier design ever published!

Please note that although these articles have been prepared for publication, circumstances may change the final content.

Here is a stereo amplifier that will equal or better any commercial amplifier, regardless of price. A no-compromise design producing more than 100W RMS per channel into eight ohms, it features full loudspeaker protection, state of the art specifications, and rugged Mosfet output stages. Other features include:

- Phono (MM and MC), CD player, tuner and auxiliary inputs.
- Full facilities for dubbing between two tape decks.
- Click-action switches for selection of Dubbing, Monitor and Source inputs, with LED indicators.
- Two-way speaker selection (Off, A, B and A + B) using heavy duty relays.
- Toroidal power transformer for very low hum and noise.
- Easy to build — all parts (including the pots, input phono sockets and loudspeaker connectors) mount directly on two printed circuit boards. Wiring has been kept to an absolute minimum.
- Massive heatsinks for adequate cooling — the heatsinks actually form the sides of the amplifier.
- Electronic input switching — no shielded cable to run.

## Marantz CD player reviewed



The Marantz CD-84 is an up-market CD player with full programming facilities and infrared remote control. January *Electronics Australia* carries a detailed review.

Plus:

- **A fully-protected 30V/1A regulated power supply**
- **Comprehensive home burglar alarm**

**ELECTRONICS AUSTRALIA** **JANUARY 1985**

# Why do AVTEK modems work better?

MultiModem and MiniModem bring superior data transfer within every computer users reach.

Using new VLSI technology, these modems use digital signal processing to achieve functions normally requiring analogue filters. The result? Reliable data transfer on terrible lines where most modems just give up in disgust! An added benefit: digital modems never require alignment.

### ● They never requires adjustment.

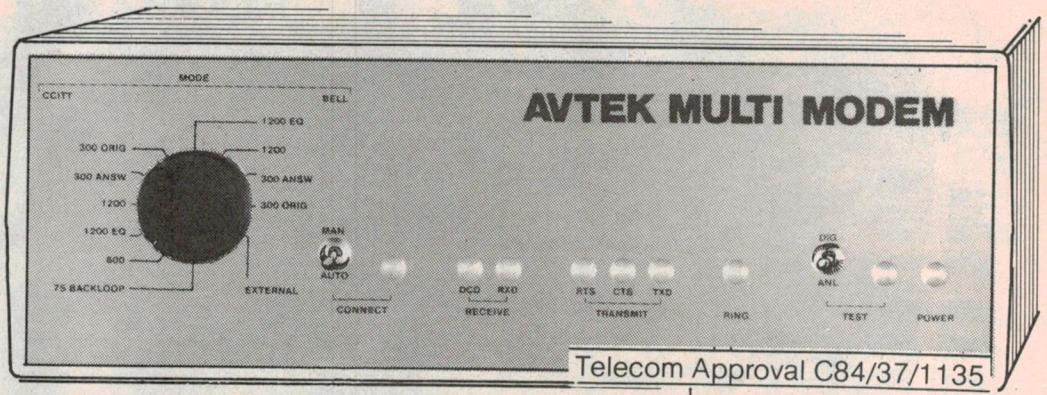
Complex modulation,demodulation and filtering functions are carried out by integrated circuit A/D and D/A convertors. A digital signal processor uses 24K of ROM and 1.3K of RAM to perform the filtering functions. Critical analogue adjustments give way to crystal locked precision.

### ● Digital filters mean less errors.

They are much sharper than on conventional modems. Line interference is screened out. You get error free data transfer, even on very noisy lines.

### Auto Answer Option

What is autoanswer? It is the ability of your computer/modem to switch into receiving mode when the phone rings. Some computer/software combinations do this.MultiModem offers the alternative, for computers without this facility – a hardware autoanswer. You can leave your computer waiting for information.




Telecom Approval C84/37/1135

| MODE | RATE | DUPLEX DESCRIPTION |
|---|---|---|
| 1 | 300 | Full Bell 103 originate |
| 2 | 300 | Full Bell 103 Answer |
| 3 | 1200 | Half Bell 202 |
| 4 | 1200 | Half Bell 202 with equaliser |
| 5 | 300 | Full CCITT V21 Originate |
| 6 | 300 | Full CCITT V21 Answer |
| 7 | 1200 | Half CCITT V23 Mode 2 |
| 8 | 1200 | Half CCITT V23 Mode 2 with equaliser |
| 9 | 600 | Half CCITT V23 Mode 1 |

### MultiModem has all the standards.

You won't be left with an obsolete product. MultiModem gives you both Australian/European (CCITT) and American (Bell) standards at 300, 600 and 1200 baud.

While most facilities currently use modes 5 & 6 (300 baud (CCITT V21), the standard for Videotext is to be modes 7-9 (CCITT V23). MultiModem is ready for future developments.

### MiniModem only $199.00 inc. phone

When only 300 baud full duplex is required, Minimodem is the right choice. Using the same digital filtering as MutiModem, it provides:

- 300 baud full duplex
- Answer/originate
- Includes phone hardwired plus plug
- Superior VLSI chip performance (identical to MultiModem).




● Telecom Approval C84/37/1173

### Baud Rate Convertor

Coming soon, this powerful accessory for the MultiModem allows computers to communicate using split baud rates (1200/75 and 600/75, 75/1200) when they do not support it internally - (e.g. Commodore, Tandy and early MicroBees.)

### MultiModem

Complete, including the phone hardwired into the modem.

**$349.00**

### Autoanswer MultiModem

Includes phone and switchable hardware auto answer.

**$399.00**

### Kit MultiModem

Save by building it yourself. Does not include phone. Not for connection to Telecom lines.

**$249.00** **(only available from Avtek)**

### Autoanswer Facility (retrofit)

Module must be fitted by Avtek.

**$59.00 plus $7.50 return P&P**

### Postage and Packing:

On Modems is $7.50 (registered). On other products is $3.00

## Products for the MicroBee

### MultiProm Interface Kit allows you to:

- Extend the ROM capacity of your MicroBee to 44K, or to a total of 308K by daisy chaining
- Takes 2532s or 2764s (can be mixed) and has 11 open collector outputs and eight buffered inputs;
- The address of the ports used for EPROM selection can be changed.
- Select between Editor/Assembler, WordBee, Logo, MiniPascal etc. with a few keystokes.

**only $99.00**

### MultiROM Boards

**XM-1**

Fits inside the MicroBee and lets you select say WORDBEE or EDASM from the keyboard. Suits all Bees with 8000 serial number (or earlier) **$19.95**

**XM-2**

As XM-1 but suits all Bees with 9000 (MicroBee IC etc) serial numbers upward **$29.95**

**XM-3**

This great little adaptor allows owners of early MicroBees which use 2532 ROMs, to use the later 2764 ROMs. **$17.95**

## AVTEK DEALERS

**Melbourne**
Rod Irving Electronics (03) 489 8866

**Perth**
Altronics (008) 999 007 (Orders)
(09) 328 1599 (Enquiries)

**Brisbane**
Jaycar (07) 393 0777

**Sydney**

| | |
|---|---|
| Paris Radio (Kingsford) | 344 9111 |
| Jaycar (City) | 267 1614 |
| Jaycar (Hurstville) | 570 7000 |
| Jaycar (Carlingford) | 872 4444 |
| Jaycar (Concord) | 745 3077 |

# AVTEK

(Electronics) Pty Ltd

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Phone 427 6688 or write to us C/O Lane Cove Post Office.



Glover & Associates

## Speech synthesiser and word processor

Dolphin Computers Pty Ltd announce the availability in Australia of the Currah Speech 64 speech synthesiser for the Commodore 64 computer. It is manufactured in Britain by Currah Computer Components.

Speech 64 is a hardware-based synthesiser. It has an infinite vocabulary with any word being made up of sound syllables, called allophones. The unit plugs onto the expansion slot at the rear of the Commodore 64 and the sound is modulated onto the TV signal. A simple Basic command starts the computer talking and most words to be spoken are entered exactly as they are read.

Speech 64 is claimed to be an excellent educational aid in teaching-type programs, speech analysis, learning to type, and introducing people with sight handicaps to computers.

Lots of "speechware" — software programs incorporating Speech 64 routines — is being released by UK software publishers.

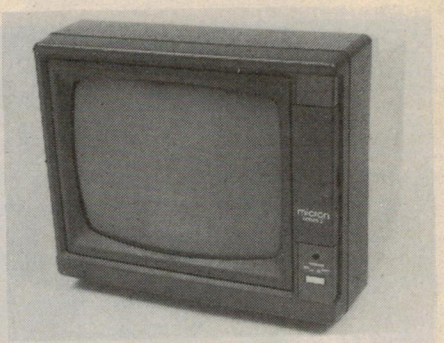
Also available from Dolphin Computers is Tasword 2, a word processor for the Sinclair Spectrum. Tasword 2 is priced at $42.00 but includes features in processors 10 times the cost.

Right justify, word wrap, text find, text copy, text move, insert and delete character or line, are some of the features included. For a home or small professional user, a Sinclair Spectrum 48K computer with Tasword 2 makes a cost-effective word processing package.

Further information from Dolphin Computers Pty Ltd, 92 Reserve Rd, Artarmon, NSW, 2064. Phone (02) 438 4933.



## High resolution monochrome monitor



Altronic Distributors announce the availability of a high resolution computer monitor, the Micron series II. Normally supplied in a non-glare green screen version, it is also available, at a slightly higher price, in a non-glare amber screen version. It is designed for 240V 50Hz operation and is fitted with a power transformer to SAA specifications.

The 30cm screen has a resolution, at the centre of the screen, of not less than 1050 lines, making it ideal for all forms of numerical and digital display. Video bandwidth is from 10Hz to 22MHz, and input impedance 75Ω or 10kΩ, switchable.

The monitor also features a 12V DC, 1.1A power supply to power the computer or anciliary equipment. Controls are provided (front) for power on/off, character brightness, intensity, and display centring; and (rear) background intensity and vertical and horizontal adjustment.

Further information from Altronic Distributors, 151 York St, Subiaco, WA, 6008. Phone (09) 381 7233.

## Hewlett-Packard portable computer

Hewlett-Packard Australia Ltd announce the release of a portable personal computer, called simply "The Portable" which they claim offers the capabilities of conventional desktop computers in a portable package. The Portable measures 330mm x 25mm x 75mm (W x D x H) and weighs 4kg. It can be carried in a briefcase.

The new computer features a flip-up, 16-line by 80-column liquid-crystal display, a full-size keyboard and built-in software (including the best-selling Lotus 1-2-3). It contains almost two-thirds of a megabyte of memory and can run industry-standard MS-DOS software and share data with HP, IBM and other personal computers.

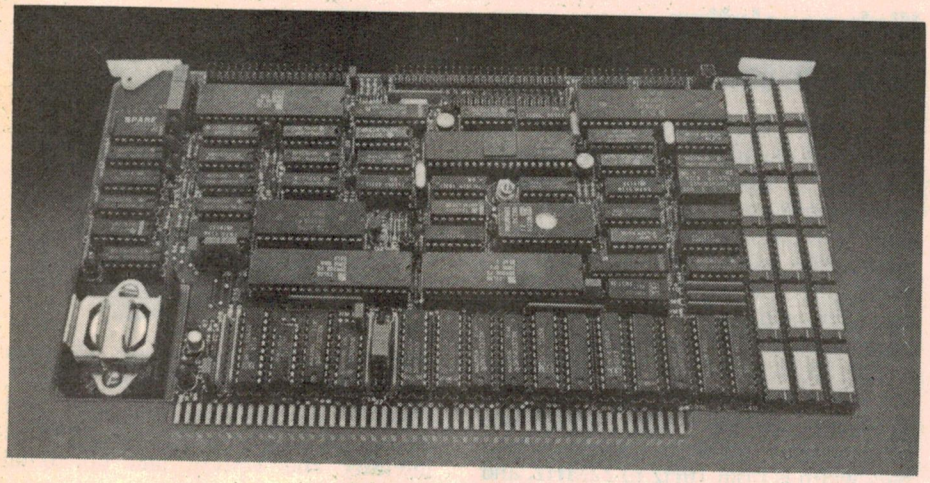
The new machine may be used as a stand-alone computer, with part of its large, continuous memory acting as a disk drive, or as a remote terminal using an Australian developed modem in the form of a portable acoustic coupler. It also functions as the central element in a complete portable computing system, with battery-powered 3½" disk drive and HP's recently introduced ThinkJet printer.

The Portable runs on rechargeable batteries for one to two weeks of normal use. There is a battery monitor to indicate how much power remains and a reminder at 20% to recharge batteries. With 5% power remaining the computer shuts down, using the remaining power to hold the data in memory. It can hold this for several weeks if the batteries cannot be recharged.

The Portable is aimed at sales managers, service or support professionals, sales people and others who want personal computing power at their fingertips.

Further information from Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn, Victoria, 3130. Phone 895 2895.





## High performance single board computer

Microtrix Pty Ltd has released a new high performance single-board computer which is available as an individual unit or as the heart of a complete computer system. Known as the Super Six, it provides everything necessary to run single-user operating systems without additional boards.

Featured on one S100 card are 128K of parity-checked RAM; a Z80B CPU operating at 6MHz; two RS232 serial ports; two parallel ports; a floppy disk controller; a direct memory access controller; monitor EPROM; and counter/timer circuit.

The floppy disk controller is capable of supporting up to four drives simultaneously. These can be a mixture of 8", 5 ¼" and 3½" units, thus making the Super Six ideal for format translation between disk types. Its versatility should gain it ready acceptance by software authors and in offices which utilise a number of different computers.

Operating systems available now are CP/M 2.2, CP/M 3.0, and single-user TurboDOS. Excellent use is made of the full 128K of memory by providing disk cache buffering and a large user TPA space. By the addition of slave processor cards, a full multi-user computer system can be configured. High performance is achieved with 6MHz processors.

Other uses for the Super Six would include data acquisition and process control systems. A companion hard disk controller is also available.

Further information from Microtrix Pty Ltd, 24 Bridge Street, Eltham, Victoria. (03) 439 5155.

## Dot printer is fast and versatile

Emona Computers has released a new dot matrix printer in its popular Emtek range. The new Emtek EX-120 printer is the successor to the EX-80 model, first released in June 1983. This new generation printer is much faster and has many enhanced features.

The EX-120 is a bidirectional, dot matrix printer, with a nine-wire head, is Epson command compatible and has a standard centronics parallel interface. It accepts either friction feed or tractor feed paper and will produce an original and two copies if required. In addition, the Emtek now prints at 120 characters per second.

One feature of the printer is the inclusion of three modes of printing. When speed is important the "Draft" mode is selected; when high quality is required the "Near Letter Quality" mode is selected; and for professional "typeset" appearance the "Proportional" mode is selected.

Both pica and elite styles of print are offered and these can be varied with the double width, compressed, elongated, subscript and superscript options that are selectable.

Further information from Emona Computers Pty Ltd, 661 George St, Sydney, NSW, 2000. Phone (02) 212 4815.


**ACME HAVE MOVED**

As from 1 October 1984

**Acme Electronics**

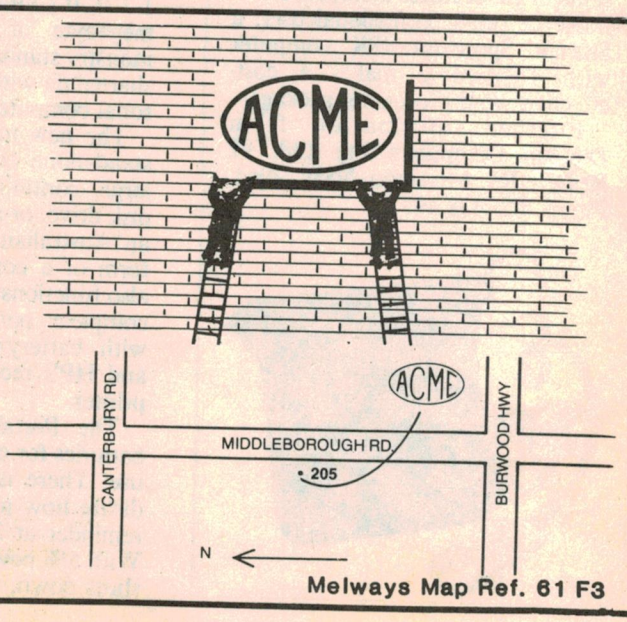
is located at

205 Middleborough Road,

(Midway between Canterbury Rd. and Burwood Hwy.)

Box Hill 3128, Victoria

Phone: **(03) 890 0900**



# M is for Monitors

MITSUBISHI ELECTRIC



All facets of industry and society are demanding higher resolution in monitors at ever lower prices.

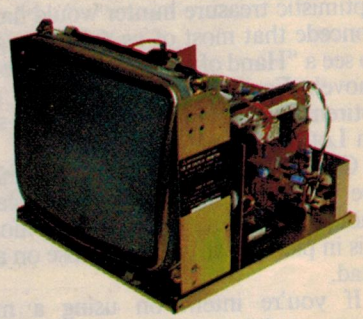
So we have responded with a two fold solution. For those who can't compromise on performance we released our Delta Gun (ST tube) colour monitors giving superb resolution, without excessive cost. Where price is critical, we offer our Precision In-Line (PIL AT and MT tube) colour self-convergence models, approaching Delta Gun performance whilst shaving costs dramatically. All monitors are available with long persistence phosphors, super high contrast glass and anti-glare screen coatings.

The choice is yours. Mitsubishi have consistently led the way in colour monitor development and are continuing to do so. And now that we have made it affordable, why not have the best?

The same is true for our Monochrome Monitors. You can choose phosphors from the range of P4 (white), P31 (green), P39 (long persistence green) and PUM (amber).

You will enjoy the crisp, stable low distortion image of our new generation CRTs, with their compact chassis and sophisticated circuits. Both colour and monochrome models are available for end users and for building into OEM equipment.

Want to feast your eyes on our big performers? Contact us now for comprehensive specifications and prices.



## Monochrome Monitors

| | | | | | |
|---|---|---|---|---|---|
| **CRT size** | 12"V*90° | | 8"V*90° | | 5"V*55° |
| **Phosphor type** | P4, P31, P39 & PUM | | P4, P31, P39 & PUM | | P4, P31 |
| **Screen Type** | Black, non-glare & regular | | Regular | | Regular |
| **Power supply** | 240V AC, 50Hz or | 12V DC | 240V AC, 50Hz or | 12V DC | 12V DC |
| **Consumption** | 30W | 1.2A | 30W | 1.0A | 0.8A |
| **Signal** – Data – HD – VD | Composite video or TTL; Pos.(300Ω) for TTL; Pos.(2.2kΩ) for TTL; Pos.(2.2kΩ) for TTL | | | | |
| **Scanning frequency** | 15.625kHz (H.), 50Hz (V.) | | | | |
| **Recommended No. of characters** | 2000 | | 2000 | | 800 |
| | (7 × 9 dot matrix) | | | | |
| **Video response (min.)** | 18MHz Comp. 25MHz TTL | | | | |
| **Geometrical distortion (max.)** | 5% | | | | |
| **Non-linearity** | 10% | | | | |
| **Operating environment** – Temperature – Humidity | –0° to +40°C; 10 to 90% | | | | |
| **Safety regulations** | Designed to meet UL, DHHS & FCC regulations | | | | |

**"V" is viewing inches of tube rather than complete diagonal dimension of tube face.**

## Colour Monitors

| | | |
|---|---|---|
| **CRT type & dot pitch** | 11"V to 25"V with 0.31mm pitch or finer | |
| **Input signal** | Composite video | 1.0Vp–p (pos.) |
| | Composite sync. | 1.0 to 5.0V (neg.) |
| | Video | 1.0Vp–p (pos.) or TTL (pos.) |
| | Separate sync. | TTL (pos.) |
| **No. of characters** | 2000 to 9000 | |
| **H. scan frequency** | 15kHz to 45kHz | |
| **V. scan frequency** | 40Hz to 70Hz | |
| **Video bandwidth** | 50Hz to 55MHz ±3dB | |

**All monitors are available with the following options:–**
- Super High Contrast glass
- Long Persistence Phosphors
- Anti-reflection bonded screen panels

**High Resolution Monitors are available as follows:**
- with or without cabinets
- with Composite, RGB TTL and RGB Analogue Inputs

NEXUS

**ELECTRONICS PTY LTD.** (Inc. in NSW)
339 Pacific Highway,
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Telephone: (02) 922 1722

SYCOM

49-53 Tope Street,
South Melbourne, 3205.
Telephone: (03) 699 8433

# BEACHCOMBER Metal Detector

*Here's a chance to build a metal locator with discriminate control and automatic zeroing. It even has a cancelling facility. With a special moulded plastic case and preassembled search coil, the Beachcomber is a snack to build and it looks superb. It is sensitive and accurate — ideally suited to finding coins and medals.*

**by COLIN DAWSON**

Now that the dust has settled from the last gold rush, we can all sit down and offer some rational thought about the business of striking it rich. Even the most optimistic treasure hunter would have to concede that most of us are never going to see a "Hand of Fate" on the end of our shovel. For those intent on an early retirement, money would be better spent on Lotto than a metal locator!

Granted, gold is still lying around by the bucketful for those with dedication enough to retrieve it. Trouble is, most of it is in pieces that you could lose on a pin head.

If you're intent on using a metal locator, a far more rewarding ambition would be to find coins, rings, watches, medals and other relatively common items. Even this modest ambition is likely to be more rewarding in terms of satisfaction than financial gain — but any amateur prospector will tell you that they only do it for "fun" anyway!

Of course the amount of fun derived from using a metal locator is rather minimal if the machine has inadequate performance. In this respect, we think that the Beachcomber should prove quite satisfying. It has a search coil that can locate small items quite accurately and there are front panel controls for most aspects of its operation.

The Beachcomber has no less than six potentiometer controls and two switches. Initially, the novice operator may well be confused but operation is really quite simple once the technique is mastered. The versatility of the machine is improved through the inclusion of these controls which compensates for the extra time spent in learning to use it.

Let's take a quick look at what all the controls are. The front panel is divided into three zones — Meter, Audio and Mode. Let's start with the Mode section. This contains the Discriminate and Cancel pots. These control the degree of metal discrimination and ground cancel respectively. For readers unfamiliar with these expressions, they are explained later.

Selection between Discriminate and Cancel modes is made by a thumb switch mounted in the handgrip. Operating this switch, which is a momentary contact type, also resets the meter needle to zero. This brings us to the Meter section of the front panel which includes the Gain Control and Zero Set. The Gain function simply determines the sensitivity of the meter (this also incorporates the power on/off switch).

The Zero Set control is a means of controlling the point to which the meter needle actually resets when it is zeroed. In most cases, this will be adjusted so that the meter (a centre zero type) is centre scale. There are good reasons, however, why this will not always be ideal — but more about this later.

The Audio section contains the Volume and Threshold controls. Volume is self explanatory; while the Threshold setting determines the amount of meter deflection that must occur before any sound is produced. The sound is related to meter deflection in frequency — greater deflection leads to increased frequency.

The only remaining control is the second switch. This switches the Beachcomber to either automatic or manual mode. In the manual mode the meter is zeroed through the operation of the thumb switch as previously described. In the automatic mode, the meter is continually zeroed automatically. The response of this function is damped so that the meter can still register a find. It takes about one second for the meter to zero from full scale.

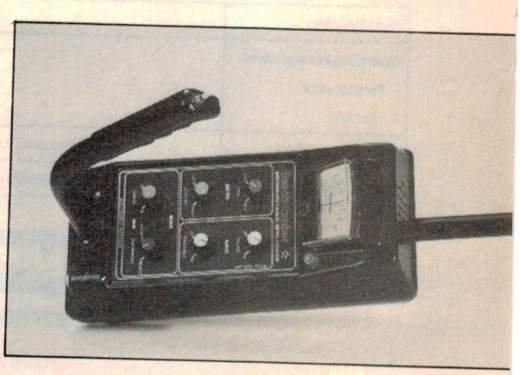
## Modes of operation

Operation of the circuit can not be explained quickly, but a brief overview of the main "blocks" would be advisable at this stage. Referring to the circuit diagram, circuitry immediately to the left of the transmit coil is the oscillator. Through inductive coupling, this signal also appears in the receive coil. Any metal brought into the magnetic field of the search head causes a change in both amplitude and phase of the received signal.

The received signal can be processed in two ways, depending on whether "Discriminate" or "Cancel" has been selected. In any case, the signal is rectified and subsequently fed to the meter driving section of the circuit (IC6a). Other circuitry in this region of the diagram is related to meter zeroing, both manual and automatic.

Shown to the right of this block is the audio section of the circuit, centred on IC7.

OK, so that's the circuit at a glance — now let's get down to details.



We estimate the cost of parts for this project to be approximately

**$239**

This includes sales tax.



## How it works

The transmit oscillator is based on one BC338 NPN transistor (Q1) and one BC328 PNP transistor (Q2). Oscillating at a frequency of about 9kHz, it produces a very nearly sinusoidal signal of up to 25V peak to peak.

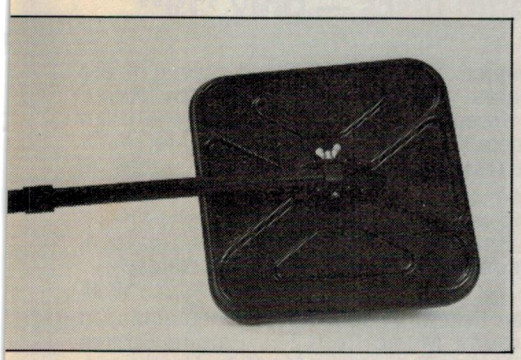
Notice that the biasing resistors for the two transistors are not identical — one has a 4.7kΩ resistor in place of an 8.2kΩ. This enables the oscillator to operate down to lower voltages than would be possible with perfectly symmetrical biasing. The resulting asymmetry of the transmitted signal is only slight and of no consequence.

Although the oscillator signal is also fed to the 4046 phase locked loop, we need not consider this aspect for the moment. Turn instead to the receive circuitry. To couple the receive coil signal most efficiently at the designed operating frequency, it is connected across a 0.22μF capacitor. This yields a nominal received signal of 70mV peak to peak at the coil.

The .022μF capacitor and 1kΩ resistor which couple the received signal to IC2a form a high pass filter. The nominal 3dB point is at about 8kHz.

IC2a is a TL062 op amp, set up as a non-inverting amplifier having a gain of 34. Actually, all of the op amps in this circuit are TL062s, the low power version of the TL072 dual op amp. It only uses about 200μA per amplifier as compared to 1.4mA for the TL072s. With six op amps in the circuit, this certainly leads to worthwhile battery savings.

When metal is introduced into the magnetic field of the search head, the phase of the received signal changes with respect to the transmitted signal. This phase effect is more pronounced for ferrous metals than non-ferrous. With respect to the amplitude, the ferrous materials will cause a small decrease whereas non-ferrous will cause an increase. In some cases, the amount of increase is quite substantial.



To take advantage of these characteristics, the discriminte mode must be sensitive to both phase and amplitude changes. This means that the received signal can not simply be rectified and used to directly drive the meter. Instead, it is "chopped", and only about half of the waveform is processed. To sense phase changes, the chopping must be performed by some control signal having the same frequency as the received signal but with independent phase relationship. This is achieved by a rather interesting means.

Notice that the output of IC2a (pin 1) is connected to two other ICs. Consider firstly IC3, the quad bilateral switch. Each of the four "gates" in this package has a pair of in/out pins, as well as a control pin. When the control pin is taken high, a low resistance path is provided between the two in/out pins. Analog signals of either polarity can be passed between these pins. Actually, two such gates are used to control the output of IC2a — IC3a and IC3b.

Only one of these gates will be on at any given time, depending on whether Discriminate or Cancel has been selected. IC3a is on for Discriminate and IC3b on for Cancel. Control of these two gates is achieved by a latch consisting of ICs 4c and 4d. Sla, which selects the mode, is a momentary-contact type — hence the necessity to use a latch.

The control pins for ICs 3a and 3b (pins 6 and 12) are connected to the latch circuitry through diodes D2 and D3. The polarity of these diodes is such that the latch can disable either of the CMOS switches but can not actually turn them on. This function must be performed by other circuitry connected to the CMOS switch control pins.

In the case of IC3a, the "on" state of the switch is controlled by IC1, the 4046 phase locked loop. In fact, it is pin 4 — the VCO output of IC1 — which controls the "on" state of IC1.

The VCO (voltage controlled oscillator) is connected so that it is operating at the same frequency as the transmit oscillator. It must, however, be made to operate at different and adjustable phase angles to the transmit oscillator. This is an essential requirement of the Discriminate function.

Recall that IC1 has a connection to the transmit oscillator output (pin 14). In fact, this connection is made through an RC attenuator consisting of the 100kΩ resistor and 47pF capacitor. These components reduce the oscillator signal to a level the CMOS IC can safely handle.

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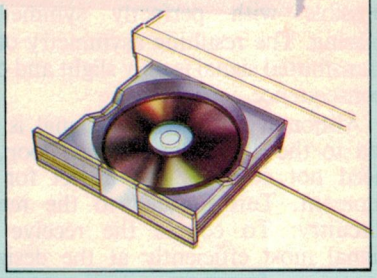



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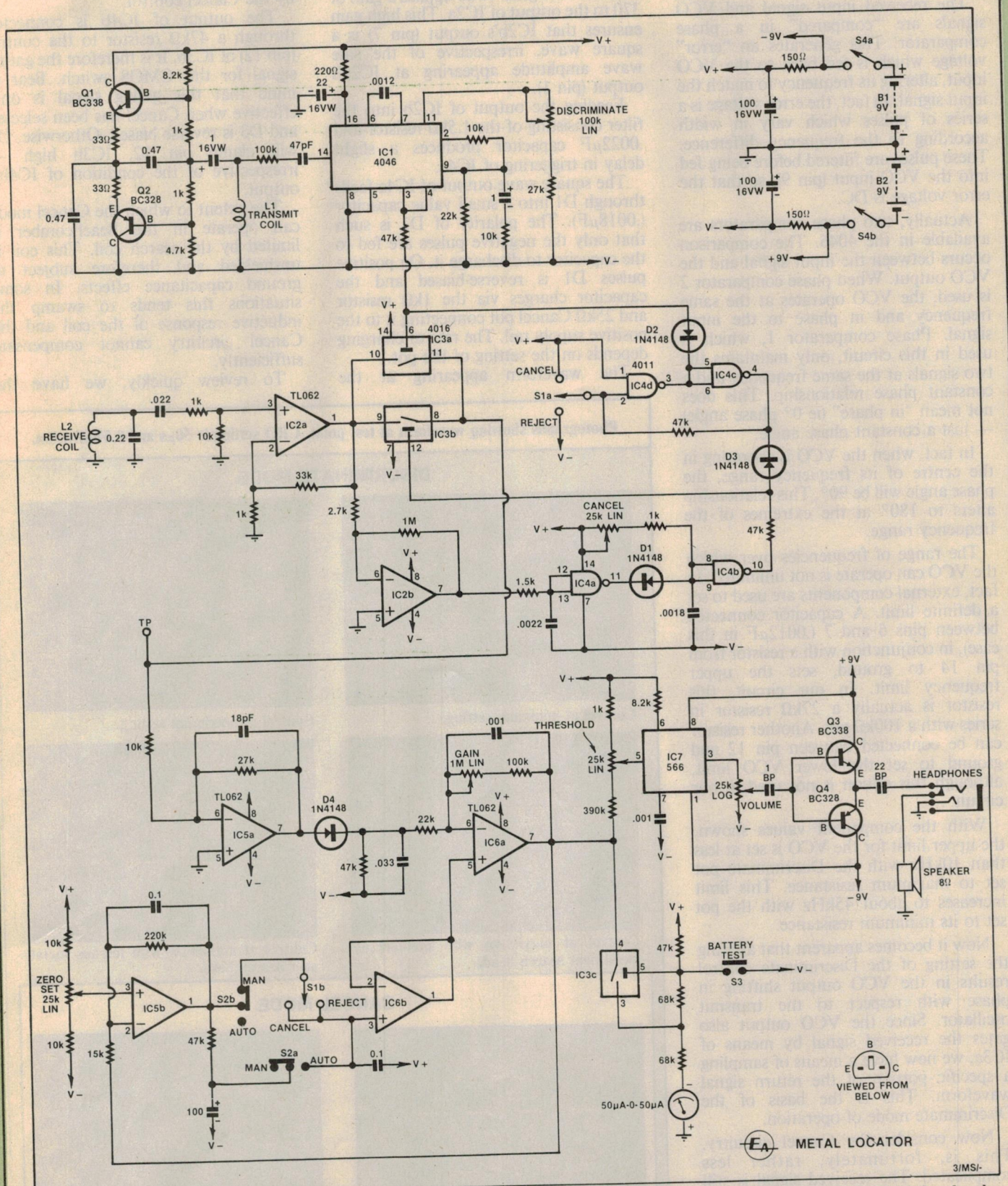

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**Metal locator circuit. A 4046 PLL provides a phase reference for the received signal and a 4016 "chops" the signal.**

The received input signal and VCO signals are "compared" in a phase comparator. This generates an "error" voltage which is fed back to the VCO input, altering its frequency to match the input signal. In fact, the error voltage is a series of pulses which vary in width according to the frequency difference. These pulses are filtered before being fed into the VCO input (pin 9), so that the error voltage is DC.

Actually, two phase comparators are available in the 4046. The comparison occurs between the input signal and the VCO output. When phase comparator 2 is used, the VCO operates at the same frequency and in phase to the input signal. Phase comparator 1, which is used in this circuit, only maintains the two signals at the same frequency and a constant phase relationship. This does not mean "in phase" (ie 0° phase angle) — just a constant phase angle.

In fact, when the VCO is operating in the centre of its frequency range, the phase angle will be 90°. This relationship alters to 180° at the extremes of the frequency range.

The range of frequencies over which the VCO can operate is not unlimited. In fact, external components are used to set a definite limit. A capacitor connected between pins 6 and 7 (.0012$\mu$F in this case), in conjunction with a resistor from pin 14 to ground, sets the upper frequency limit. In our circuit, this resistor is actually a 27kΩ resistor in series with a 100kΩ pot. Another resistor can be connected between pin 12 and ground to set the lower VCO limit, although this option is not used in our circuit.

With the component values shown, the upper limit for the VCO is set at less than 10kHz with the Discriminate pot set to maximum resistance. This limit increases to about 45kHz with the pot set to its minimum resistance.

Now it becomes apparent that altering the setting of the Discriminate control results in the VCO output shifting in phase with respect to the transmit oscillator. Since the VCO output also gates the received signal by means of IC3a, we now have a means of sampling a specific portion of the return signal waveform. This is the basis of the Discriminate mode of operation.

Now consider the Cancel circuitry. This is, fortunately, rather less complicated. The received signal is still chopped by a CMOS switch (IC3b), but there is no phase detection. The Cancel mode is only sensitive to amplitude changes.

The control signal is now derived from the received signal rather than the transmitted signal. IC2b applies a gain of 370 to the output of IC2a. This high gain ensures that IC2b's output (pin 7) is a square wave, irrespective of the sine wave amplitude appearing at IC2a's output (pin 1).

Feeding the output of IC2b into the filter consisting of the 1.5kΩ resistor and .0022$\mu$F capacitor produces a slight delay in triggering of IC4a.

The square wave output of IC4a feeds through D1 into a small value capacitor (.0018$\mu$F). The polarity of D1 is such that only the negative pulses are fed to the capacitor to discharge it. On positive pulses D1 is reverse-biased and the capacitor charges via the 1kΩ resistor and 25kΩ Cancel pot connecting it to the positive supply rail. The rate of charging depends on the setting of the pot.

The waveform appearing at the capacitor is used to trigger IC4b. This means the output of IC4b is a series of positive pulses with duration determined by the Cancel control.

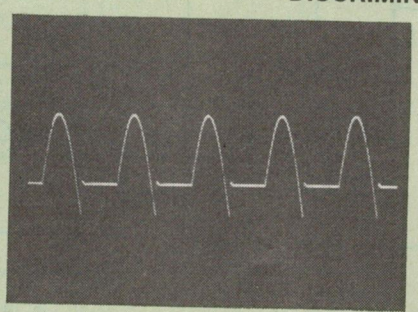
The output of IC4b is connected through a 47kΩ resistor to the control (pin 12) of IC3b. It is therefore the gating signal for this CMOS switch. Bear in mind that this gating signal is only effective when Cancel has been selected and D3 is reverse biased. Otherwise, D3 will clamp pin 12, IC3b high — irrespective of the condition of IC4b's output.

The extent to which the Cancel mode can operate in the Beachcomber is limited by the search coil. This coil is unshielded and therefore subject to ground capacitance effects. In some situations this tends to swamp the inductive response of the coil and the Cancel circuitry cannot compensate sufficiently.

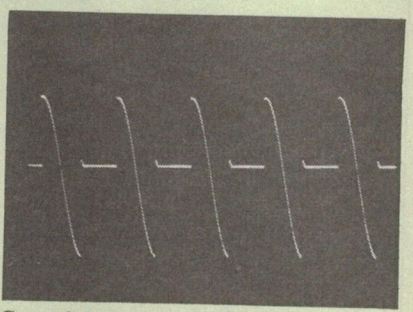
To review quickly, we have the

**Photographs showing waveform at test point. CRO setting is 50$\mu$s and 0.5V/division.**

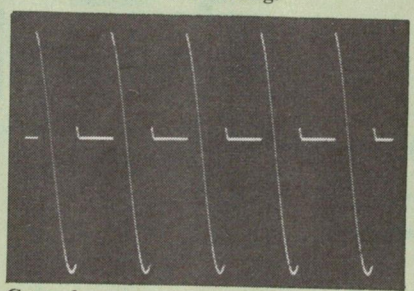
**DISCRIMINATE MODE**



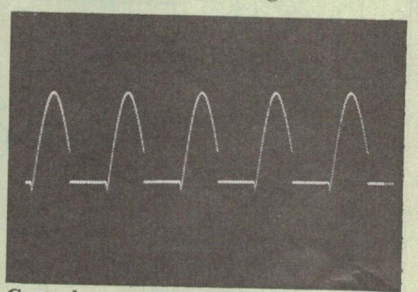
Control at minimum setting.



Control at maximum setting.

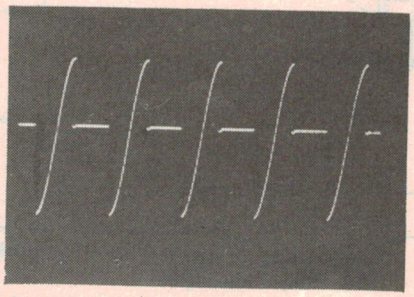


Control at maximum with non-ferrous metal near search head.

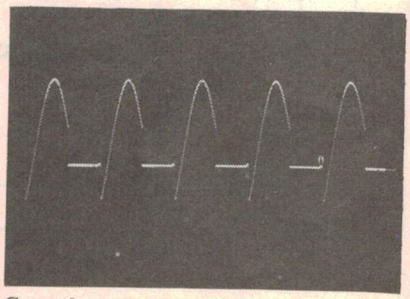


Control at maximum with ferrous metal near search head.

**CANCEL MODE**



Control at minimum setting.



Control at maximum setting.

situation where the signal available to the meter driving circuit can be derived from either a phase and amplitude sensitive detector (IC3a) in the case of Discriminate, or an amplitude-only detector (IC3b) in the case where Cancel is selected.

The chopped signal, as derived from IC3, is immediately amplified by IC5a. This is a simple inverting amplifier having a gain of about 2.5. Its output (pin 7) is fed into a capacitor via D4. The capacitor used here (.033$\mu$F) has a 47k$\Omega$ bleed resistor across it which sets the "normal" level across it to a convenient voltage.

The voltage appearing across the .033$\mu$F capacitor ultimately determines the amount of meter deflection, although it must first be amplified. This is the purpose of IC6a. This provides a gain of up to 41, depending on the setting of the 1M$\Omega$ gain potentiometer.

Notice that the non-inverting input (pin 5) of IC6a is not connected to the 0V rail as we might normally expect. Instead, the voltage reference for this pin is derived through the meter zero circuitry. This senses the amount of offset appearing at the output of IC6a (and therefore at the meter) by means of IC5b.

To activate the meter zero circuitry, S1 must be operated. As we have already seen, S1a will select the mode of operation but, simultaneously, S1b will be causing the zero circuit to operate. Assuming that S2 is in the manual position, S1b would then connect the output of IC5b to the non-inverting input (pin 3) of IC6b, thus charging the 0.1$\mu$F capacitor. An amount of offset is now produced at the output of IC6b which is in proportion to the amount of offset in the meter.

Notice also that the output of IC6b is connected back to the input of IC6a. Since IC6a originally produced the meter offset, a correction voltage is now applied to its non-inverting input which exactly compensates for that offset. The meter will then be zeroed.

Because IC6b has the 0.1$\mu$F capacitor connected to its non-inverting input, it functions as a sample and hold. Even after S1 is released, the correction voltage is "held" in the 0.1$\mu$F capacitor. Of course, this correction voltage is only applicable at the time of S1's operation. Any offset produced after this time will result in meter deflection — until such time as S1 is operated again and the circuit zeroed.

In this way, any meter deflections resulting from changes in the controls (such as a mode change) or environmental conditions can immediately be nulled. Once zeroed, the meter will deflect in the normal way should a "find" be made.

So far, we have assumed that S2 is in the manual zero position. Should it be selected to the automatic position, two changes occur. Firstly, the path from IC5b to IC6b via S1 is broken. This prevents S1 from activating the zero mechanism. Secondly, an alternate path from IC5b to IC6b is provided. This path is via the 47k$\Omega$ resistor and 100$\mu$F capacitor. These components now provide a permanent path for the zero signal so that it is effective continuously.

A delay is thus provided by the 47k$\Omega$ resistor and the 100$\mu$F capacitor so that any "find" will not be instantly nulled. The meter will deflect for about one second before zeroing is effective. Note that if the circuit is held over a metal object for more than one second in this mode, the meter will still zero.

The unfortunate consequence of this characteristic is that if the metal is now removed, a secondary meter deflection will result. This deflection is in the opposite direction to the initial deflection — in other words, a metal which was initially rejected will now produce a brief accept signal. The simple way to avoid this problem is to make sure that the circuit does not have time to zero over any piece of metal.

The 25$\Omega$ Meter Zero pot sets the point to which the meter will return when it is zeroed. By altering the reference voltage appearing at the non-inverting input (pin 3) of IC5b, it alters the circuit's response to any given offset. This must be adjusted while S1 is operated, otherwise the altered zero point will not become apparent until the next time S1 is operated. Normally, the zero point will be set for zero meter deflection (centre scale), but this is by no means essential. The meter could be zeroed to a position left of centre or even full scale left. This would provide greater resolution for metals in the accept region.

Additionally, the audio section, which produced a frequency in proportion to the meter deflection, could be made to operate with improved resolution by this means.

A CMOS switch (IC3c) is included in the circuit between the output (pin 7) of IC6a and the meter. During normal operation, the 47k$\Omega$ resistor connected to the control of this switch (pin 5) ensures that it is on, ie low resistance from pin 4 to 3. This permits normal meter operation. If, however, the battery test switch (S3) is operated, pin 5 of IC3c will be pulled low, switching it off.

Simultaneously, S3 will provide a connection for the meter to the negative supply rail through the 68k$\Omega$ resistor. The meter is now measuring the negative supply rail. No facility to test the positive


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supply rail has been provided, but the current drain on the two rails is equal. This means that both battery packs will drain at the same rate — only one of them need be tested.

In our Beachcomber, the meter has full scale readings of ±30. New batteries produced a deflection of around 27. When the reading fell to below 20, the batteries were due for replacement. Other meters may have different scales which will necessitate calibration with known reference voltages. The batteries can be regarded as flat when the supply has fallen to ±4V, measured after the 150Ω resistors.

Only the audio section of the circuit remains to be described. This is reasonably straightforward. It is based on an LM566 VCO (IC7). Only two external components are needed to set the normal operating frequency of this device, a capacitor and a resistor. We have chosen .001μF for the capacitor (connected to pin 7) and 8.2kΩ for the resistor (connected to pin 6). A control voltage applied to pin 5 shifts the normal frequency over a large range.

In this circuit, the control voltage is taken from the output of IC6a and therefore varies in proportion to the meter offset. The 25kΩ Threshold control is used to calibrate the audio section so that no noise occurs until metal is detected. Initally, only a low "ticking" will occur. With increasing meter deflection, this will rise to a low growl and finally a humming sound. The audio detection circuitry is most sensitive when in the "ticking" range.

As the LM566 cannot drive the speaker directly, a buffer section has been included. This consists of Q3 (BC338 NPN) and Q4 (BC328 PNP). Drive for these transistors, taken from the square wave output of IC7 (pin 3), passes through the 25kΩ Volume pot.

Space is provided in the Beachcomber case for a headphone socket. This must be wired so that the stereo headphone speakers are in series.

The positive and negative supply rails are connected to their respective battery terminals through 150Ω resistors. The purpose of these resistors is mainly to reduce the supply to the CMOS ICs. With new batteries, the total supply voltage would be about 19V but, in most cases, the CMOS ICs are designed to operate with a maximum supply of 15V. With the 150Ω resistors in circuit, the supply is reduced to around ±6.2V for a total of 12.4V — well within the CMOS range.

The 150Ω resistors also reduce the current drain — particularly in the early part of the battery cycle where it might otherwise be excessive. Note that the resistors should not be omitted or substituted — the Discriminate control would not have the correct range of adjustment.

The audio section of the circuit is operated directly from the batteries. This section, which is quite rugged enough to withstand the higher voltage, has a fairly heavy current drain once the audio threshold has been exceeded. This would lead to severe fluctuations in the circuit voltage if we attempted to operate the audio section through the resistors.

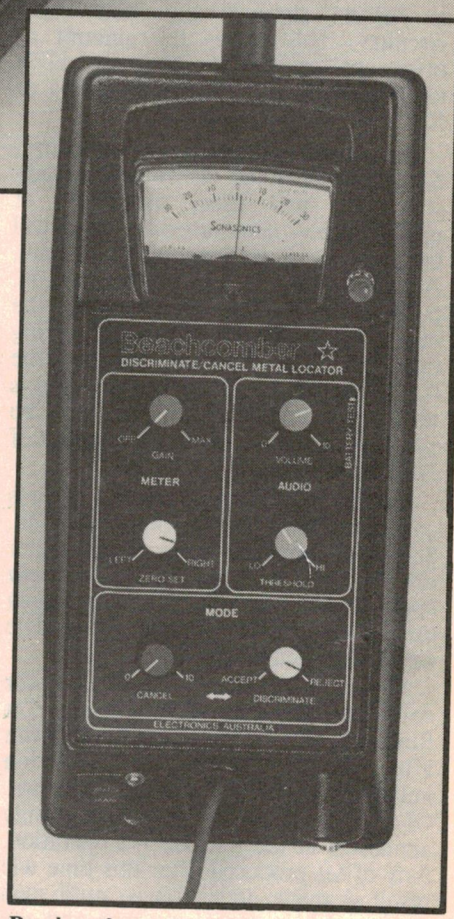
## Construction

The special moulded plastic case, centre zero meter and search head assembly used in the Beachcomber are available from all Jaycar stores.

By using these ready-made parts, you will be able to get a really attractive project without investing too much effort. Begin construction by cutting the pot shafts down to size. The pots will all be mounted on the PCB later — it is very much more awkward to cut the shafts then. For the particular knobs we used, 10mm shafts were needed.

A few other tasks should be completed




**Beachcomber controls (top). Note the mode switch in the handle.**

**Beachcomber front panel with the handle removed for clarity (above).**

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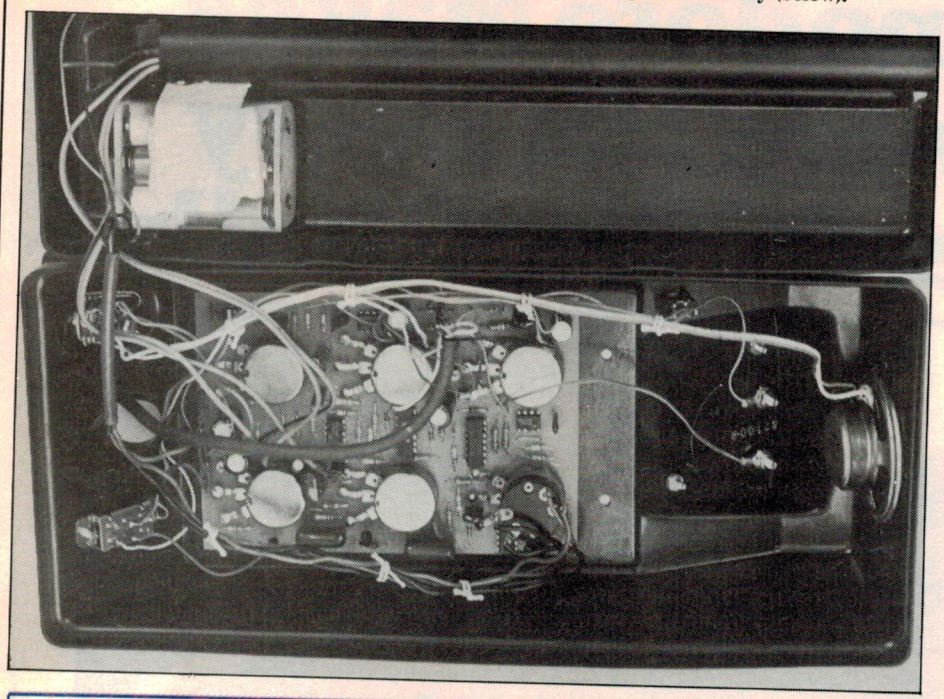
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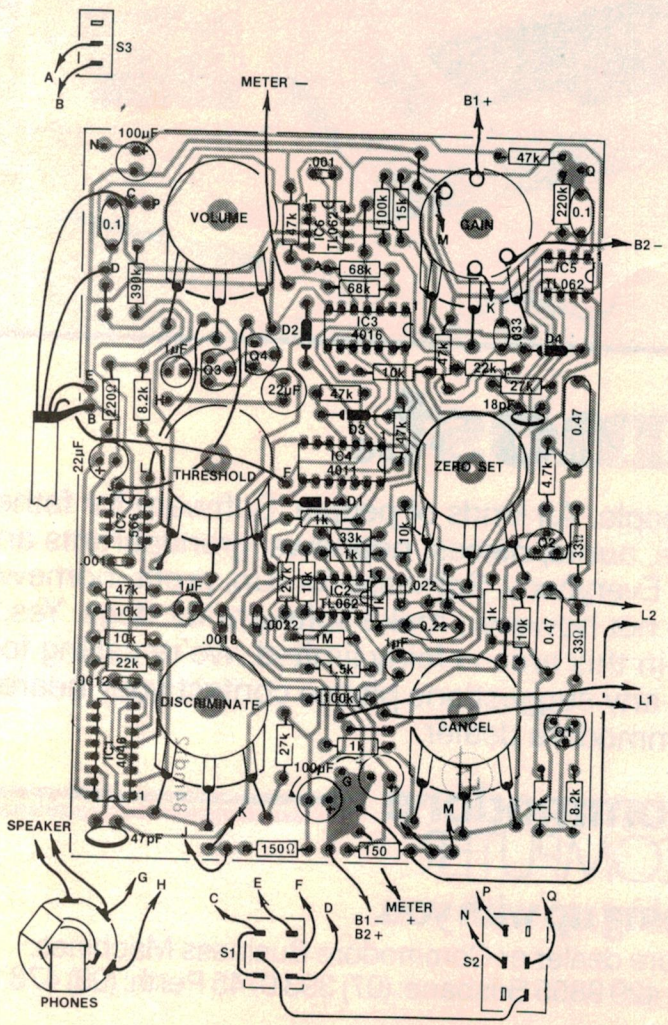
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BMS/cc.263

# Beachcomber

Inside view of the Beachcomber (above) and the component overlay (below).






## PARTS LIST

1 moulded plastic case (see text)
1 meter to suit case (50µA-0-50µA)
1 search head assembly
1 PCB, 143×101mm, code 84md12
1 DPDT momentary contact switch
1 DPDT slider switch (Jaycar cat. 0821 or equiv.)
1 SPST momentary contact switch
1 6.5mm stereo phono socket
1 50mm 8Ω speaker
6 knobs to suit potentiometers
2 6 × AA cell battery holders
2 screws (to suit slider switch)
25 PCB pins

***Semiconductors***

2 BC338 NPN transistors
2 BC328 PNP transistors
1 4046 CMOS phase locked loop
1 4016 CMOS quad bilateral switch
1 4011 CMOS quad NAND gate
3 TL062 dual op amps
1 566 function generator
4 1N4148 diodes

***Capacitors***

3 100µF/16V electrolytics
1 22µF/16V electrolytic
1 22µF/16V bipolar electrolytic
3 1µF/16V electrolytics
2 0.47µF metallised polyester (greencap)
1 0.22µF greencap
2 0.1µF greencap
1 .033µF greencap
1 .022µF greencap
1 .0022µF greencap
1 .0018µF greencap
1 .0012µF greencap
2 .001µF greencap
1 47pF ceramic
1 18pF ceramic

***Resistors (¼W, 5%)***

1 × 1MΩ, 1 × 390kΩ, 1 × 220kΩ, 2 × 100kΩ, 2 × 68kΩ, 6 × 47kΩ, 1 × 33kΩ, 2 × 27kΩ, 1 × 22kΩ, 1 × 15kΩ, 6 × 10kΩ, 2 × 8.2kΩ, 1 × 4.7kΩ, 1 × 2.7kΩ, 1 × 1.5kΩ, 5 × 1kΩ, 1 × 220Ω, 2 × 150Ω, 2 × 33Ω.

***Potentiometers***

1 × 1MΩ log switchpot, 1 × 100kΩ linear, 1 × 25kΩ log, 3 × 25kΩ linear.

***Miscellaneous***

Hook-up wire, 5-core cable (see text), machine screws, solder.

before assembling the PCB. Drill a series of holes in the front of the case to form a speaker grill, then glue the loudspeaker in place. Also check that S2 (the Auto/Man. switch) aligns properly with its mounting holes. We found that the mounting holes — just to the left of the handle — needed to be enlarged just a



**Inside the search head. The transmit and receive coils overlap by about 25mm.**

touch. Now mount the Scotchcal front panel and label adjacent to S2. Finally, drill a hole in the end of the handgrip to mount S1.

Now you're ready to start work on the PCB. It measures 143×101mm and is coded 84md12. PCB pins will have to be used for this project — it is not practical to make connections any other way. The pins should be inserted before any other components — there are 25 in all.

Next should come the links. There are six mounted on the PCB — leave the four insulated links running between PCB pins until the wiring-up stage.

Now mount the rest of the components. Although the pots should be left until last, each one will connect to the board by means of three short pieces of tinned copper wire. These should be soldered in place now.

Two sets of pot nuts are required for this project. One set fixes the pots to the PCB and the other clamps the pots to the case. Having taken care of this last aspect, turn now to the wiring.

S1 is mounted in the handle and a total of 5 connections must be made to it. We used a 55cm length of 4-core shielded cable, but ordinary hook-up wire is probably quite adequate. In any case, leave some extra length to permit the hand grip and S1 to be removed if necessary.

It is essential that the two coils in the search head are connected with the correct polarity. Transposing the connections for one coil will mean that the received signal is out of phase with the oscillator. This, of course, would play havoc with the phase sensing circuitry. One of the insulated wires connecting to each coil has a black stripe on it. Connect this to V− for the transmit coil and 0V for the receive coil.

The only components mounted in the bottom half of the case are the batteries. Make sure that the wires connecting to them have plenty of spare length to facilitate disassembly of the case. The battery pack holders already fitted to the case were intended for larger battery packs. A piece of styrofoam under each one will help to hold the smaller 9V packs in tightly.

Before switching on, set the Discriminate and Cancel controls to the full anti-clockwise position, volume to minimum, Threshold to minimum, Zero Set to about half range and S2 to Man. Now switch on and set the gain to about half range. Switch S1 to the left — the meter should deflect. Adjust the Zero Set and ensure that the meter responds. If not, there is a fault.

Now release S1 and make an adjustment to the Cancel control. The meter indication should change as the control reaches the extreme of adjustment. If not, try adjusting the Discriminate control. If the meter responds to this, S1 is installed "back-to-front". Either rotate it in the handle or transpose its V+ and V− connections.

Assuming that normal responses have so far been obtained from the machine, operate S1 to the right and repeat the zeroing test. Release the switch and adjust the Discriminate control — again, check for some meter deflection.

So far so good? Then turn the volume up to maximum and increase the Threshold through its full range. The sound should range from the aforementioned ticking to a squeal. At this stage you might also want to try the Beachcomber out with a pair of headphones (the internal speaker should be silenced when you insert the headphone jack). You will need to turn the volume down when using the headphones.

Now for the clincher. Set the Discriminate control to maximum and zero the meter (S1 to the right). Put a coin on the ground where you can be certain that there are no buried metal objects. If you can't guarantee this last requirement then put the coin on a large cardboard box instead of the ground. Move the search head back and forward over the coin, steadily decreasing the height until meter deflection occurs.

Depending on the gain setting, this should happen somewhere between about 2cm and 15cm. Try decreasing the amount of Discrimination. The coin should always register, although the sensitivity may decrease with lower discriminate settings.

Replace the coin with a similarly-sized ferrous object. This should register as an accept with the Discriminate control at minimum and a reject with the control at maximum. Somewhere between these extremes, the ferrous object should be completely ignored.

You could now try the automatic zeroing — select S2 to the Auto position. Repeat the Discriminate test with the coin, but keep the search head moving over it. A brief meter deflection should occur at each pulse. Now try with the ferrous object. The negative meter deflection will still occur — but so too will a brief "shadow" pulse in the positive direction. This is unavoidable, but by moving the search head fairly briskly, the effect will be minimised.

Be sure to develop a reasonable level of familiarity with the machine before taking it out in the field. Practice with coins, rings, aluminium ring-pulls and other items which you are likely to encounter. Bury some of them at depths up to 5cm.

## Operating instructions

1. Auto/Man to Man.
2. Volume to max.
3. Threshold to min.
4. Discriminate to max.
5. Cancel to min.
6. Switch on, leave Gain at min.
7. Press the thumb switch to the right and hold.
8. Adjust Zero Set to centre the meter needle.
9. Adjust Threshold so that the sound is just stopped.
10. Release the thumb switch.
11. Put a $1 coin or other test item on the ground.
12. Move the search head from side to side as you slowly approach the coin.
13. Replace the coin with steel washer, nut or similar item.
14. Reduce the Discriminate control in steps and repeat (12).
15. Press the thumb switch to the left.
16. Replace coin and repeat (12) whilst making adjustments in steps to the Cancel control.
17. Replace the coin with the washer.
18. Repeat 16.
19. If the meter drifts from zero during any of the steps (when no metal is present), reset it by operating the thumb switch (right if in Discriminate mode, left for Cancel).

This should give you some idea of the responses you can expect from the Beachcomber. Generally, it is preferable to use the Discriminate mode rather than Cancel as a slightly greater sensitivity is provided. Always use the lowest practical gain setting. Higher settings will increase the chances of an erroneous detection. One other point — remember to switch the Beachcomber off while digging to conserve the batteries.

# Beachcomber

There are some important limitations which you should be aware of. Because of the search coil configuration, the Beachcomber is more suitable for hunting small items such as coins. These can usually be detected with a fair degree of accuracy because the true "search" area of the head is a narrow strip (no more than 2.5cm) running most of the length of the head on its for-aft axis. Outside of this region, readings are not valid.

In fact, to either side of the "hot spot", negative detection areas exist. These will cause a smaller deflection of the meter in the opposite direction.

Hence for a typical find, the meter will respond with a small negative deflection, followed by a large positive deflection, before swinging negative again.

The Beachcomber is not capable of discriminating against large ferrous objects. Large, in this case, refers to any object which is significantly larger than the "hot spot" of the coil. In practice, this is not a serious limitation. Clearly, any object which causes massive deflections of the meter should be regarded with suspicion, particularly if it is buried deeper than a few centimetres.

With respect to mineralised ground, the Locator will generally operate with reduced sensitivity. The worst case is wet sand at the beach. Only very shallow items can be expected to register. Note that where the soil is uniformly mineralised — as distinct from fluctuating — the Discriminate mode will probably yield slightly improved sensitivity. The Cancel mode is mainly of use where the soil tends to vary with each step.

## Troubleshooting

If your Beachcomber refuses to co-operate, and there is no fault in the wiring or soldering, here are some troubleshooting procedures which may help. Firstly, if you have an oscilloscope the accompanying waveform photographs can be referred to. These show the correct waveforms at the test point — the outputs of IC3a and IC3b.

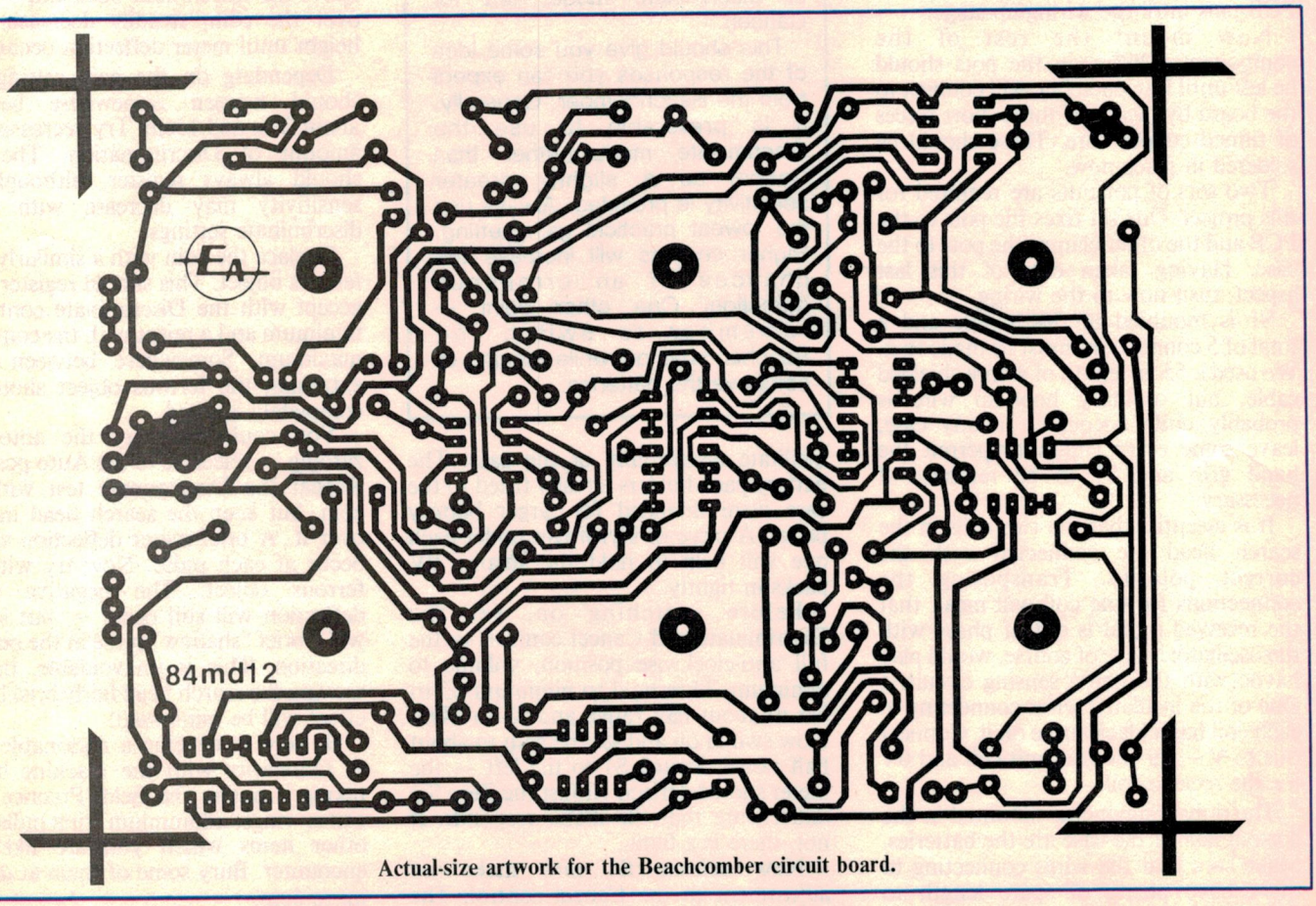
If you do not find very similar waveforms, this is cause for concern. A sine wave or a square wave is most definitely wrong. The distinctive chopped signal should be evident. If only the sine wave appears, there is no gating signal. Determine whether this is so for both Discriminate and Cancel modes. If a square wave appears at the test point, then no received signal is reaching IC3. This could point to a fault in either the receive circuitry of the oscillator.

Assuming that the correct waveform appears at the test point, any problem would most likely be in the meter zero circuitry. This can most easily be checked with the receive coil disconnected. Operate S1 and alter the setting of the Zero Set control.

If there is no response when S1 is operated, check that some voltage is actually being applied to pin 3 of IC6b. If not, trace back through the wiring to IC5b (pin 1 initially, then pin 2). If S1 causes meter deflection but the Zero Set doesn't change it, check the voltage at pin 3, IC5b. This should alter in response to the Zero Set.

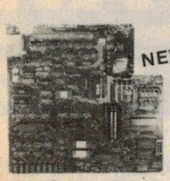
If you have only a multimeter, disconnect the transmit coil. The voltage at pin 1 of IC2a should now be very near to 0V. The voltage at the test point should also be 0V in the Discriminate mode, irrespective of the setting of the Discriminate pot. In the Cancel mode, check that the voltage at pin 7, IC2b is also 0V. If pin 10 is low then no conclusive measurement can be made at the test point.

Where there appears to be a problem in selecting or changing the mode, measure the voltage at pin 4, IC4c. This should be high when Cancel is selected — it should stay high, even after S1 is released. Pin 4 should stay low when Discriminate is selected.




Actual-size artwork for the Beachcomber circuit board.

# COMPUTER BOARDS



NEW PRODUCT!

## EXCALIBUR

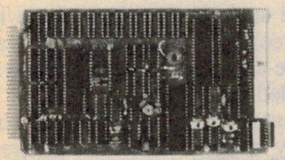
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- ★ 24 lines by 80 characters 7 x 12 dot matrix (monitor required).

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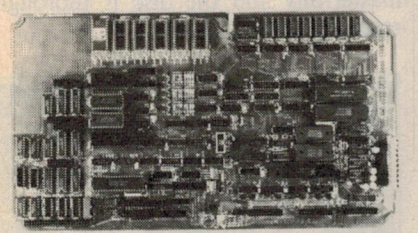
- ★ 4 MHz Z80 CPU!
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## BIG BOARD II

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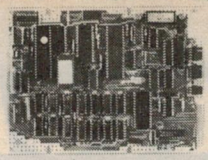
FEATURES ...

- ★ **4 MHz Z80 CPU AND PERIPHERALS CHIPS:** The Ferguson computer runs at 4MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.
- ★ **64K RAM + 4K STATIC CRT RAM 24K (E)PROM OR STATIC RAM:** "Big Board II" has the three memory banks: the first memory bank has eight 4164 RAM's that provide 60K of user space and 4K of monitor space. The second memory bank has two 2K and 8 SRAMs for the memory-mapped CRT display and space for six 2732s or 2K x 8 static RAMS, or pin compatible (E)PROMs, the third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full Kit, or assembled and tested, it comes with a 450nS2732A EPROM containing the monitor.
- ★ **MULTIPLE DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS:** The "Big Board II" computer has a multiple density disk controller, it can use 1793 or 8877 controller chips. The board has two connectors for disk signal with 34 pins for 5¼" drives, the other with 50 pins for 8" drives.
- ★ **VASTLY IMPROVED CRT DISPLAY:** The "Big Board II" computer uses a 6845S CRT controller and 8002 Video Attributes controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5 x 7 dot matrix on 15.75 KHz monitors and a 7 x 9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.
- ★ **STD BUS CONNECTOR:** "Big Board II" brings its bus signals to a convenient place on the PC board where users can solder a STD socket, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry standard card cages.
- ★ **A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS.**
- ★ **TWO Z80A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS:** The "Big Board II" has two Z80-A CTCs. One is used to clock data into and out of the Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.
- ★ **PROM PROGRAMMING CIRCUITRY AND SOFTWARE:** The "Big Board" computer has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)PROMS. (Software $25 extra).
- ★ **CP/M CAPABILITY:** CP/M with Russell Smith's CBIOS for the "BIG BOARD II" is available ..... (plus tax) $230

The CBIOS 5" or 8" is avail. separately ..... (plus tax) $65

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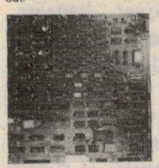


## THE LITTLE BIG BOARD

FEATURES:

- ★ Z80A CPU (4 MHZ)
- ★ 65,536 bytes of RAM.
- ★ Two RS232C I/O ports.
- ★ Battery back up realtime clock and calendar.
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- ★ Full STD. Bus.
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- ★ On board 80 x 24 video for a low cost console. Uses 2716 Char. Gen. Programmable Formats. Uses 6845 CRT Controller.
- ★ ASCII Keyboard parallel input interface. (6522).
- ★ Serial I/O (6551) for RS232C or 20 MA loop.
- ★ Centronics compatible parallel printer interface. (6522).
- ★ Buss expansion interface with DMA Channel. (6844).
- ★ Dual timer for real clock application.
- ★ Powerful on board system monitor. (2732). Features commands such as Go To, Alter, Fill, Move, Display, or Test Memory. Also Read and Write Sectors. Boot Normal, Unknown, and General Flex.
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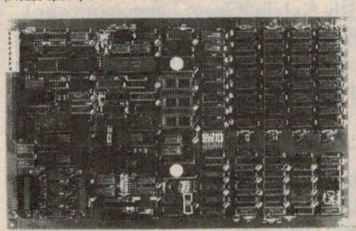
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THE ORIGINAL

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- ★ **64K RAM:** Uses industry standard 4116 RAM's. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.
- ★ **Z-80 CPU:** Running at 2.5 MHz. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffeted and runs 8080 software.
- ★ **BASIC I/O:** Consists of separate parallel port (Z80 P10) for use with an ASCII encoded Keyboard for input. Output would be on the 80 x 24 Video Display.
- ★ **24 x 80 CHARACTER VIDEO:** With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix, upper and lower case.
- ★ **FLOPPY DISK CONTROLLER:** Uses WD 1771 controller chip with a TTL Data Seperator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disk drives. Directly compatible with standard Shugart drives such as the SA800 or SA8001. Drives can be configured for remote AC off/on. Runs CP/M 2.2.
- ★ **PFM 3.3 2K SYSTEM MONITOR:** The real power of the Big Board lies in its PFM 3.3 on board monitor. PFM commands include: Dump Memory, Boot CP/M, Copy Examine, Fill Memory, Test Memory, Go To, Read and Write I/O ports, Disk Read (Drive Track, Sector), and Search PFM occupies one of the four 2716 EPROM locations provided.
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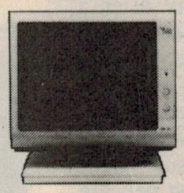
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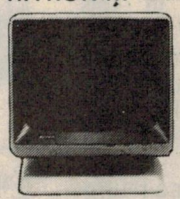
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## MAHLER

**Symphony No. 1 including the Blumine movement. Boston Symphony Orchestra conducted by Seiji Ozawa. DGG Signature Series Analog Disc 410 845-1.**

Returning to this symphony after a long absence one senses the commonplace quality of much of the thematic material. But there is much ingenuity in the working out and spacing of this same material. There is also the merit of using an orchestra of such great dimensions to produce the most delicate sounds.

It is perhaps news to many musicians that Mahler originally wrote this symphony in five movements and it was only as an afterthought that he cut out what was known as the "Blumine" movement. It is included in this recording, a sentimental section featuring a trumpet solo. It runs nearly six minutes. Its omission gives the symphony no extra dimensional balance; it simply reduces it to a more formal outline.

What struck this listener after a return from an absence of many years is the amount of time wasted in the introduction to the first movement with its too-faintly heard trumpet fanfare, which however improves later when the sound grows louder. Like a chef composing a dish Mahler adds ingredient to ingredient as he goes along.

This he stirs at times and lets simmer, and at others brings it to the boil of an hysterical sounding climax using the true first subject in the process. Somehow it never seems overpoweringly imperative. The trumpet solo at the beginning of the second (Blumine) movement might well be cynically reminiscent of busking.

Follows the rustic sounding landler with its many bludgeoning climaxes. It has a very sweet trio section. The Funeral March of the third movement in the more popular revised score is based on a cynical treatment of the French ditty Frere Jacques. It is all very interesting, at times beguiling, and seems to flow more easily than the other more sharply chiselled sections where many of the seams show.

Not unexpectedly the quiet ending to this movement gives way after a pause to an almighty crash in the first bar of the finale — with much braying in the brass. The second subject, however, has its own loveliness. Ozawa takes everything according to Mahlerian tradition and the only fault to be found in his standard reading is that one feels his urging of the orchestra in the accelerandos. The analog sound is used efficiently. (J.R.)




**Carmina Burana (Cantiones profanae). Radio-Symphony-Orchestra and Choir of Berlin with Sylvia Greenberg (soprano), James Bowman (counter tenor), and Stephen Roberts (baritone). Conducted by Riccardo Chailly. Decca Digital Disc 411 702.**

Carmina Burano is a work you hate to love. Examined closely after its first tremendous impact it reveals material that is by any standard inconsequential. Yet the work has knocked you for a loop. Why?

Its appeal is elemental. It relies mostly for its effect on the most primitive form of music, rhythm, which the Berlin Orchestra exploits with splendid vigour. It is so forceful that you find yourself wanting to foot-tap at its sheer pulsing energy.

This reception is not a matter of on and off; it persists throughout the whole work. One remains fascinated by the plainsong-like chanting of the chorus and the depth of appeal of the vocal soloists. Its many swift changes of tempo and the raffishness of the words all help to leave one helplessly receptive. And its performance on this disc has much to recommend it.

The attack is immediate, simultaneous and aggressive. When not impressing by its forthright pugnacity it demands the highest respect of its audience for such feats as staccato clipping of phrases, dead on-spot intonation and first class tone control.

The vividness of the recorded sound would reveal the slightest hesitation or inaccuracy. None is to be heard. And despite the surface simplicity there is a cunningly conceived attack on ears and nerves. The complex accenting is always well attended to.

The counter tenor has a useful voice intelligently used. I had to admire it though it is a production I dislike. Stephen Robert is a good baritone with excellent diction. Sylvia Greenberg's girlish soprano can sometimes be very moving, and is always bracing to listen to.

Balance between voices and orchestra is never less than perfect and the work's unique cantata form is resolutely preserved throughout. Conductor Riccardo Chailly handles all his forces masterfully and the disc is thoroughly recommended. (J.R.)




## JANACEK

**Glagolitic Mass. Teresa Kubiac (soprano), Anne Collins (contralto), Robert Tear (tenor), Wolfgang Schone (bass), John Birch (organ), Brighton Festival Chorus, Royal Philharmonic Orchestra conducted by Rudolf Kempe. Decca Jubilee Series Analog Disc 411 7261.**

First let us get the question of the word Glagolitic out of the way.

# TAPES
## NTEREST

According to the sleeve notes, which I quote because I have no knowledge of such matters myself, "Glagolitic refers to the ancient script — an early form of Cyrillic — in which the Slavonic text had originally been written. The text that Janacek used, however, was more recent, sanctioned for occasional use by the Catholic Church (rather than the Orthodox) and printed in 1921 in a Czech Catholic musical periodical.

"Janacek subjected it to anachronistic Czech first syllable stress and made small textual alterations during composition, such as the repetition of Veruju (I believe) which recurs hauntingly through the Credo. Glagolitic is also cognate with the Czech word Hiahol — a joyful sound (as of bell or voices)".

The music is vintage Janacek, ejaculatory, short phrases barked out, sometimes lyrically and repetitiously delivered, the whole knitted into a beautiful and usually eloquent pattern. The score opens with trumpet passages that might have been taken from the Sinfonietta. It is an arpeggiato phrase presented with characteristic scoring and later transferred lyrically to the vocal line in a sweet version.

The soprano part, taken through a very extensive range, has a wide Eastern European wobble, pulsing enough for Fred Astaire to have put a tap dance routine to. Despite this occasionally unpleasant event, the sound is on the whole excellent, flowering into a monothematic all embracing theme.

A fair sounding tenor fights a very high tessitura bravely. There is much lighthearted joy in Faith in the following Credo. It all sounds very comfortable in Czech despite unfamiliarity with the language necessitating a bar-to-bar following in the libretto provided with the record. Throughout the Mass, Janacek uses his style, without precedent or disciple, way out of the usual traditions of Western music, a rogue composer challenging all comers — successfully. Little is heard among the other orchestral instruments until a short episode in this Credo.

The Credo is the kernel of the Mass. Some bell-like scoring announces the introduction to the sweet Sanctus. In this the tenor has a forceful role which he releases into a wobble as wide as the soprano's.

Quiet serene music introduces the Agnus Dei. Here the solo male singer, listed as a bass, is much more like a baritone. The organ starts with a fast ostinato bass line and there follows an extension until an organ "play-out". An orchestral interlude brings this delightful exercise to a graceful finish. (J.R.)




## JAZZ CLASSICS

**New Orleans; Jazz Classics in digital stereo, Volume 1. LP album, reprocessed from original 78s. ABC Records, L-38149. (Distributed by Festival).**

The story behind this particular group of records was featured on page 20 of the September issue: "The Big Bands Live Again". In a nutshell, jazz enthusiast, broadcaster and recording engineer, Robert Parker, has meticulously reprocessed selected 78s from his huge collection, using modern equipment to re-balance and enliven the sound, and to virtualy eliminate the characteristic surface crackle. Transferred to a modern LP pressing, the sound is far better than would ever have been available to purchasers of the original recordings.

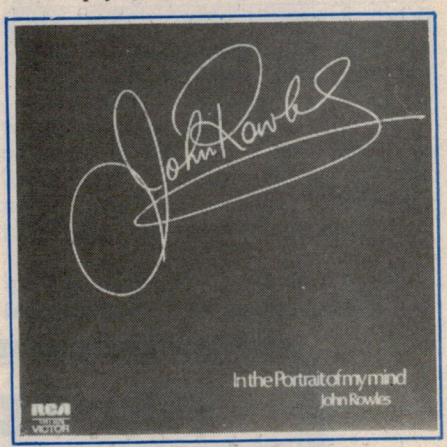
As with the earlier Glen Miller album (RCA Victor VPL1-0428), the absence of 78 rpm surface crackle is almost uncanny, particularly as it has been achieved without sacrificing half of the music! On the contrary, the bass here is firm and the treble bright, with the sound image further enlivened by the judicious use of simulated stereo and reverberation.

The oldest selection in the album is "The Original Dixieland Jazzband", recorded in July, 1918. According to Robert Parker "There can be no doubt that (this band) started the craze for jazz, which changed the face of popular music forever . . ."

Two other tracks come from the era of mechanical recording — 1923 in both cases — but the remaining 13 (1926-1932) would have been electrically recorded. All relate to the jazz scene in New Orleans, its birthplace.

With 16 tracks, it is not practical to list the bands and titles here but rest assured that, if you invest in a copy, you will get with it all the information you need: bands, titles, composers, time and place, personnel and comment. Robert Parker has done his homework well!

Would I recommend the album? If you're a jazz freak from way back, most decidedly. If you're not — then best you make up your own mind! (W.N.W.)




## JOHN ROWLES

**In the Portrait of My Mind; John Rowles, with orchestra and chorus. Stereo LP, RCA Victor VLPI-6676.**

John Rowles may be known to you, either from other recordings or from a recent visit to Australia. RCA describe him as a young man with a rich and full voice, a resident of Hawaii and a regular performer on the Las Vegas type circuit.

In the deeper register his voice reminded me somewhat of Kamahl but, in the sound and mannerisms further up the scale, there were touches of Elvis P.

In strict middle-of-the-road manner, backed by orchestra and chorus, he presents a program of 10 romantic songs: In the Portrait of My Mind — If I Could Write You For My Song — Thank You With Love — In These Times of Indecision — Love Forever Today — Tomorrow Will Be Cancelled Without You — Sending You My Dreams — Please Wait For Me — There Must Be a Softer Word Than Goodbye.

It's a pleasant club style program, tuneful and well recorded. (W.N.W.)




## IN SENTIMENTAL MOOD

**Foster & Allen: I Will Love You All of My Life. Starcall/Powderworks stereo LP POW-6789. Distributed by RCA.**

The style of this album can scarcely be in doubt, with a rose and a Valentine emblem on the front, a long list of sentimental songs on the back, and a note to the effect that it was recorded in Dublin.

What you get is a string of 16 sentimental songs, sung in traditional Irish baritone style, with crystal clear diction and generous string backing, punctuated every now and again by a burst of lively accordian. To some it will be "luvverly", to others rather boring.

For the sake of the first group, here's a sampling of the titles: Forever and Ever — Maggie — I'll Take You Home Again Kathleen — When I Grow Too Old to Dream — Mull of Kintyre — The Mountains of Mourne — Come Back Paddy Reilly.

Whether you would want to play all 16 tracks straight through may be open to question but, if you like the old sentimental songs, you'll certainly get your money's worth with a virtual hour-long program. (W.N.W.)

## AUSSIE C&W

**Buddy's Country: Buddy Williams. Stereo 12in 45rpm. RCA Victor TEP-0424.**

Buddy Williams and his music have been around for the best part of 50 years, so he ought to know something about "Buddy's Country".

On the opening track, "Dingo", he




laments our treatment of the unfortunate animal, friend of the black man but a victim of the whites.

He laments also the inequities he has observed in this, "Our Milk and Honey Land": the "swaggies" and the under-privileged; the generations who have suffered in futile wars and who could suffer again if some had their way.

But he also remembers the good side: the country "Where the White-Faced Cattle Roam" and "Over the Valley" where lies home and the one who waits for him.

Well recorded, it's a sincerely presented snippet of Australian country music from a popular old-timer. Playing time is about 15 minutes. (W.N.W.)



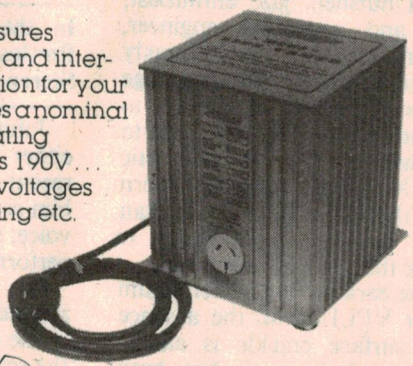

## HOOTS MON!

**The Big Yin. More words and music from Billy Connolly, Volume Two. Powderworks LP, POW-3022. Distributed by RCA.**

I've always been fascinated by the Edinburgh accent but as to the more extreme Glasgow variety, I'm not so sure. In his first track, "Glasgow Accent", Billy Connolly explains why he uses it in most of his appearances: "because I have

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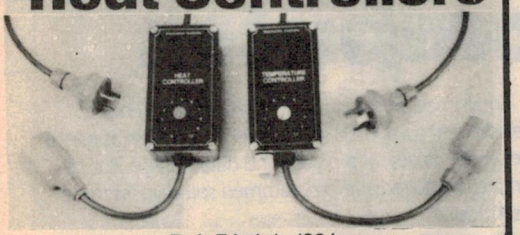


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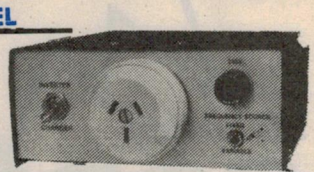
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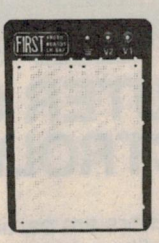


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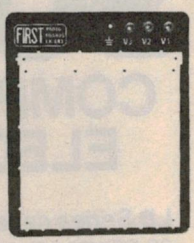


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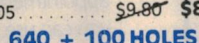
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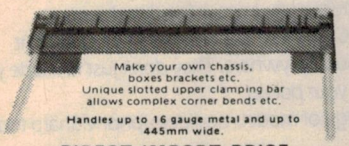
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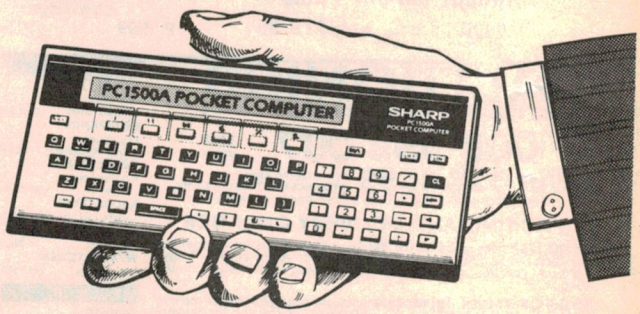
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great difficulty in doing any other!"

Fairly obviously, neither the accent nor the rather loud instrumental accompaniment prevented his audience from enjoying what followed, but a good deal of it left me guessing. From the credit on the label "ATV Northern", I would assume that all of the tracks on the disc were from TV studio performances before a live audience. I should mention, however, that they are variously dated from 1969-1974.

Track titles are: Glasgow Accents — Near You — Harry — Oh Dear — Why Don't They Come Back to Dunoon — Cruisin' — A Life in the Day Of . . .

On screen, Billy Connolly is usually good for a laugh but these soundtrack clips will work best for those who know him well enough to supply their own visual images. (W.N.W.)




## TWO SYMPHONIES

**Beethoven: Symphony No 5 in C minor, Op 67; Symphony No 8 in F major, Op 93. Played by the Dresden Philharmonic Orchestra conducted by Herbert Kegel. Compact disc, Capriccio 10003. [From P.C. Stereo Pty Ltd, PO Box 272, Mt Gravatt 4122. Phone (07) 343 1612.]**

To the best of my knowledge, this is the first time the "Capriccio" label has been mentioned in these columns. It is, in fact, one of two new CD labels which have been acquired for Australian distribution by P.C. Stereo Pty Ltd, the other being "Bellaphon".

Pressed by Sanyo in Japan for Delta Music GmbH, of Konigsdorf, Germany, Capriccio compact discs are processed through all stages "at full digital level", say the manufacturers, without resorting to analog at any point.

The initial release of 12 compact discs includes a full set of Beethoven symphonies — a first for the CD format. All feature the Dresden Philharmonic Orchestra, conducted by Herbert Kegel.

This particular disc (10003) contains the Fifth and Eighth Symphonies which, with a combined playing time of around 57 minutes, add up to very good value.

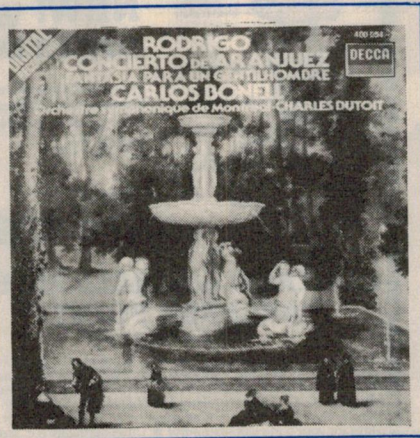
Beethoven completed the Fifth Symphony in the spring of 1808, with the first performance in Vienna, in December of the same year. Its basic theme, according to the notes, is "from struggle into the light", the recurrent opening chords and much of what follows being suggestive of the French Revolution. More recently, the "struggle" theme, plus the chords which spell out the letter "V" in Morse Code, earned for the "Fifth" the title "Victory" Symphony.

At first hearing, Kegel's opening Allegro sounded a trifle too "con brio", although the difference between his reading and that of Ozawa on Telarc amounts to less than 20 seconds. Kegel takes the second movement marginally slower than Ozawa, however, and overall playing time is about the same.

What the Capriccio recording does have is a full-bodied sound, appropriate to the work, but free of congestion and with excellent definition.

By comparison, the "Eighth" is a somewhat shorter, lighter work, constructed on the framework of what was originally intended by the Composer to be a piano concerto. It appears less frequently in the catalogs than the much-recorded "Fifth" but it makes a very acceptable "coupling" for it on this new disc.

Overall, I was quite impressed with this first example of the Capriccio label and, if it is representative of what is to follow, Capriccio CDs will be a valuable addition to the P.C. Stereo catalog. (W.N.W.)



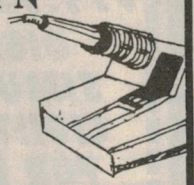


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## RAILMASTER KIT

REF: EA SEPTEMBER 1984

This is the most up to date train controller kit we've seen in a long time. It offers all those wanted features including inertia, full overload protection and walk around throttle. Kit includes front panel, correct console box and all parts.
Cat. KA-1560

**$79.95**

## DIESEL SOUND SIMULATOR WITH LIGHTING CIRCUIT FOR RAILMASTER

REF: EA NOVEMBER 1984

You will be amazed how authentic this kit sounds. Kit includes PCB and all parts for sound effects as well as all the components for the lighting circuit.
Cat. KA-1561

**$19.95**

## NEW - "HI-TECH" WALL POSTERS

A departure from our area of electronic hardware, but we think that you will be as impressed as we were when you see these magnificent posters. Shown below are descriptions of a small range of posters. We may increase this range depending on the response.

**BOEING 767 COCKPIT** A magnificent wide-angle view of a new Boeing 767 flight deck on the tarmac at dusk. The photograph is taken from the entrance to the flight deck. In the foreground is a clear view of the new all-electronic instrumentation which is a feature of this aircraft. On the far right is the engineer's console. A typical airport runway can be seen through the pilots windscreen. Full technical specs appear on the bottom edge of the 530(H)x 825(W)mm poster, which is printed in full colour on art paper.
**Cat. BP-9210** _____ **$5.95**

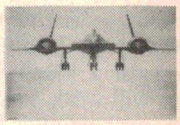
**SR-71 "BLACKBIRD" Reconnaisance aircraft** This is a superb front-on shot of the super-secret SR-71 standing on a remote runway. The photograph clearly illustrates the very low Cd of this aircraft, which can fly higher and faster than virtually any other. A truly remarkable example of High-Tech despite the fact that it was designed many years ago now. Once again, full 530(H)x825(W) colouor. (The aircraft is painted black).
**Cat. BP-9212** _____ **$5.95**

**"LAMBORGHINI"** How could you ever be upstaged in a Lambo? Well if you haven't got the $A200 grand that one will cost you here you can have a magnificent poster of a red Countach for $5.95. This 530(H)x825(W)mm poster shows this classic vehicle contemptuously parked across the yellow line of a lonely road.
**Cat. BP-9214** _____ **$5.95**

**"CORVETTE"** This is a photograph of the 1984 model Corvette. This model was completely re-engineered and is a major departure from conservative engineering practice. Many European style mechanical features around. It is rumoured that they may arrive in Australia in numbers... We think that it is the best-looking example of the marque yet. The car is painted in black against a red background. 530(H)x825(W)mm.
**Cat. BP-9216** _____ **$5.95**

Buy any 2 of the 4 posters for only **$4.95 each!**







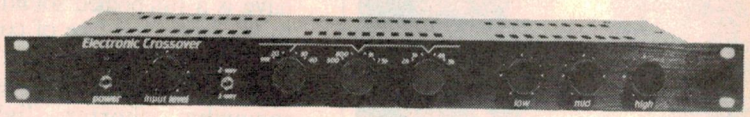


## NEW KIT ELECTRONIC CROSSOVER

REF: EA NOVEMBER 1984

This much sought after kit is now finally available. The unit is for stereo with 2 crossover points for each channel for 3 way speakers. Commercial units are almost double the price.
Kit comes complete with silk screened, rack front panel and quality English made Lorlin switches.
Cat. KA-1570

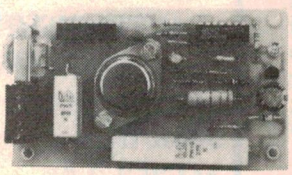
**$199**




## BRAKE LAMP FLASHER

This little device will flash accessory brake lights three times when the brake pedal is depressed. If you've had a rear end collision you will know how handy this device is.
PCB and components only. REF: EA NOVEMBER 1984
Cat. KA-1564

**$16.50**

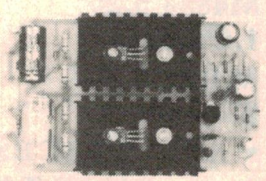


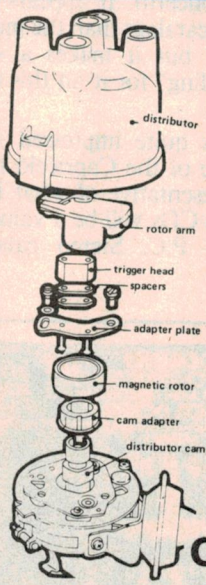
## 20 WATT LOW COST AMPLIFIER

Ref: EA NOVEMBER 1984

This amplifier module uses only a handful of parts and is simple to build. Kit includes pre-drilled heatsinks which mount on the board.
Cat. KA-1567

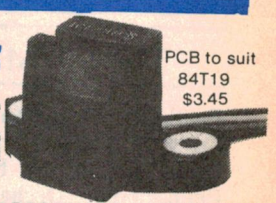
**$17.50**






## HALL EFFECT SWITCH VANE INTERRUPTED $19.95

If you have a car that won't take the Jaycar KJ-6655 Hall Effect Kit (i.e. an Australian six or V8) this could be for you!
It is the SIEMENS (German) made Hall Switch. It will operate from −30 to +130°C. A simple soft iron vane cut with appropriate slots will commutate the unit.
Cat. HK-2101



PCB to suit 84T19 $3.45

## TRANSISTOR ASSISTED IGNITION HALL EFFECT "BREAKERLESS" VERSION - $36.95

This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ-6655 Hall Effect Triggerhead.
Cat. KA-1505

## NEW! VANE INTERRUPTED HALL EFFECT SWITCH INTERFACE!

Ref: EA September 1984

This upgrade kit enables you to convert your existing points-type Transistor Assisted Ignition to the new Siemens Vane Interrupted type (i.e. for Australian 6 cylinder & V8's).
The upgrade kit includes new PCB and conversion components. The other components come from your existing TAI.
Cat. KA-1503

**ONLY $4.95**

Cat. KJ-6655

**ONLY $29.95**

## CONTACTLESS HALL EFFECT "BREAKER POINTS"

REF: EA DECEMBER 1983

A professionally engineered electronic ("breakerless") contact breaker system. Jaycar has the complete Hall Effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following: ★ Hall Effect triggerhead ★ Magnetic rotors for both 4 and 6 cylinder cars ★ Over 6 cam-lobe adaptors ★ Over 12 different adaptor plates for your particular distributor ★ Other hardware (i.e. screws etc) ★ As easy to install as a set of points ★ Simple instructions for fitting included.

## TRANSISTOR ASSISTED IGNITION $35

REF: EA JANUARY 1983

Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and diecast box - as used in the original EA unit.
Beware of flimsy kits that use sheetmetal boxes! This kit is designed to be used with contact breaker points, if you want Hall Effect breakerless option may we suggest the KA-1505 listed above.
Cat. KA-1506

# 5000 POWER AMPLIFIER

# "BLACK MONOLITH"

*REF: ETI JAN/MARCH 1981




## COMPLETE "BLACK MONOLITH" KIT ONLY

Cat. KE-4200 **$319.00**

# "BLUEPRINT"

REF: ETI JUNE/OCTOBER 1981

## 5000 CONTROL PREAMPLIFIER $299

## FOR THE COMPLETE KIT

Cat. KE-4202



Latest addition to the' thoroughbred 5000 series stable! David Tillbrook has once again produced a 'No Compromise' design. This new component, a ⅓ Octave Equaliser, gives you ABSOLUTE CONTROL over the acoustics of your particular listening enviroment. You get 3 SEPARATE CONTROLS for each and every octave of audio bandwidth to virtually eliminate the subtle nuances that are particular to your listening area.

⅓ Octave Equalisers have been used by professional engineers in Recording Studios and live concerts for over a decade now. It is no accident that the advent of the ⅓ octave equaliser and studio quality live sound recording have gone hand in hand.

### BUT FOR YOU THERE'S A CATCH!!

For Hi Fi stereo one of these units is not enough. They are mono so you will need one for each channel. Quite a lot of money really, but worth it if you want the best. Remember that whilst this unit is designed to operate in the 5000 system it will work with other Hi Fi equipment, line level in, line level out.

The Jaycar kit includes a fully pre-punched plated chassis, pre-punched heay gauge front panel silk-screened to match the other 500 components. It is absolutely original but includes such refinements as quality I.C. sockets, UNBRAKO socket head fixing screws, and brushless-look toggle switches.

You can purchase the kits one at time at $199 each or, two, $389 - a $10 saving.

If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.

Cat. KE-4204

### SPECIFICATIONS

| | |
|---|---|
| SIGNAL TO NOISE | −102dB with respect to 1 Volt |
| FREQUENCY RESPONSE | 12Hz - 105kHz to −1dB |
| BOOST/CUT | 14dB (28dB total) |
| DISTORTION | 100Hz - 0.007% |
| | 1kHz - 0.007% |
| | 10kHz - 0.008% |
| | (essentially irrespective of cut or boost) |
| CURRENT COMSUMPTION(DC) | Approx. 100mA @ ±15V (requires 30V AC CT) |
| | Output short-circuit proof |

FEATURING THE FANTASTIC 5534 IC AND STATE-OF-THE-ART J-FET OP AMPS

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# ELECTRIC FENCE

Ref: EA September 1982




**$15.00**

Mains or battery powered,this electric fence controller is both inexpensive and versatile. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian standard 3129. (Kit does not include automotive ignition coil which is required).

**Cat. KA-1109**

# 50/500MHz DIGITAL FREQUENCY COUNTER

Ref: EA Dec 1981/Feb 1982

High performance kit that uses just 5 IC's to measure periods and frequencies up to 500MHz. Everything about the Jaycar kit is special from its gold plated BNC input connectors thru to the special pre-punched heavy plastic front panel that is silk screened in epoxy ink. The standard kit works to 50MHz.

Cat. KA-1390

## ONLY $119

A 500MHz prescaler kit - fits directly onto main circuit board in above unit.

Cat. KA-1392

**$29.50**

# 12/230V - 300W INVERTER

Cat. KA-1114

**This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output is voltage regulated, gives a precise 50Hz and has current limiting with ultimate thermal shutdown. The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.**

REF: EA JUNE 1982

# $195

# 3-50V/5 AMP VARIABLE POWER SUPPLY $149

Ref: EA May/June 1983

A brand new efficient design provides regulated high power. It features state-of-the-art switchmode techniques, dual meters and continuous adjustment. All parts for the kit are provided including specified case, front panel and special meter scales.

**Cat. KA-1520**

*This kit represents a massive saving over equivalent built units! ± 12V add-on kit (refer EA July 1983)*

**Cat. KA-1521 $14.95**

## ★ NEW ★

# "SQUEAKY CLEAN" MAINS FILTERS

Two fantastic low cost models. MS-4010 will supply up to 4 appliances. Each 240V socket is isolated from the other, i.e. interference from disc drives is decoupled from the CPU power supply etc.

It will supply up to 4 outlets with a total load of 6 amps (unswitched)

Cat. MS-4010

## ONLY $99

Single 10 amp line-socket type filter (unswitched).

Cat. MS-4012

## ONLY $29.95

# DUAL TRACKING ±22V POWER SUPPLY

Ref: EA March 1982



This versatile dual polarity (dual tracking) power supply kit can provide up to ± 22 volts at up to 2 amps. In addition the supply features a fixed +5V at 0.9A output. The supply is completely protected against short circuits, overloads and thermal runaway.The kit comes complete with case,meter and front panel.

# ONLY $89.50

**Cat. KA-1410**

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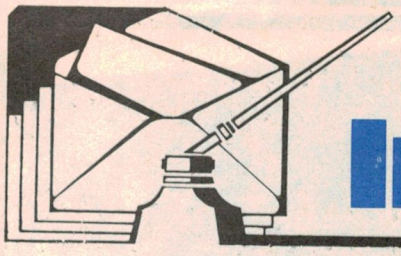
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# Information centre

## Comparison of TAI and CDE designs

I have read with interest the various articles about electronic ignition systems for cars published in *Electronics Australia*. I have built your latest design of Transistor Assisted Ignition with success, and also a capacitive discharge system of my own design. There are several points in relation to the subject that deserve mention.

Firstly, as stated in the article by John Clarke in page 52 of the September 84 edition, there are advantages to be had from the addition of solid-state triggering by the Hall-effect switch, and one of these is the elimination of "timing scatter" due to distributor cam lobe wear. However, it is a mistake to believe tht timing scatter due to distributor bearing wear will be eliminated. This is because just as when using contact points, there is erratic sideways movement of the distributor shaft. This can cause the vanes of the new rotor button to enter the Hall-effect sensor's air gap sooner or later, at random.

Secondly, your Transistor Assisted Ignition has a very high dwell angle to achieve high energy sparks even at high sparking rates. This feature has the disadvantage of high power consumption and the ignition coil overheating at low engine revs. Would it be possible for you to come up with an improved version that would reduce the dwell-angle at low engine revs (say for sparking rates below 100 per second)? This would be achieved by increasing the "off" time of the transistor carrying the ignition coil's current, at low sparking rates.

Thirdly, some comments about the alleged disadvantages of CDI. These have been listed in your past articles as mainly:

(a) Crossfiring, especially on 8-cylinder engines.

(b) Excessively short spark duration.

My CDI has worked without failure in a 6-cylinder Datsun and an 8-cylinder Ford for over 2 years without crossfire ever being evident. Spark plug gaps of up to 1mm have been tried.

I would be interested to know as to exactly under what conditions this behaviour is evident, as I have varied high tension lead spacing and routing without cross-firing ever happening — the engine always run smoothly. The problem of misfire in pollution-control cars is eliminated by my CDI design, which features an unusually long duration spark of at least 0.6ms (0.2ms being common for most CDIs).

The circuit is similar to most CDI designs in that it uses a converter producing about 400V DC to charge the 1.5$\mu$F discharge capacitor. When the contact points open, a monostable pulse generator generates two pulses with their leading edges starting simultaneously. One of these is 0.6ms long and triggers the SCR so that it undergoes three (not one as in most CDIs) current oscillation cycles lasting for at least 0.6ms.

The current path is ignition coil primary winding — discharge capacitor — SCR in one direction; ignition coil primary winding — discharge capacitor — diode bridge in the other direction.

The 0.9ms pulse stops the operation of the converter so that the SCR does not short-circuit the 400V DC output when triggered.

I have used the 0.9ms pulse to drive the moving coil mechanism of a tachometer, without using the tachometer's other circuitry. The system consumes about 1A at idle speed in a 6-cylinder car and does not perceptibly heat up the ignition coil.

The design (enclosed with letter) may look overly complicated but several simplifications are obvious which would achieve a moderately complex electronics ignition system with all the advantages of CDI and as far as I know none of its disadvantages. (L.H., Concord West, NSW).

● It is true that bearing wear in a distributor will cause a certain amount of timing scatter. However the amount is small compared to the timing scatter caused by conventional points. So the Hall effect device really does give a big improvement in overall timing and the engine does run much more smoothly.

It is true that the TAI does make the coil run vey hot however we have had no reports of coil failure due to this cause. It would be possible to produce a circuit which would reduce the dwell angle at low engine revs but whether this would make a great difference to the overall coil dissipation is doubtful.

We are also dubious about increasing the complexity of the circuit. In our opinion, the existing TAI design already borders on the too-complicated although it has proved to be reasonably reliable in practice. But consider this, the TAI as published by *EA* is far more complicated and nowhere near as reliable as the breakerless ignition systems installed as original equipment in the majority of new cars these days. By all accounts, they are very reliable.

If you have not experienced cross-fire with your CDI you have either been extremely lucky or cannot recognise it when it occurs. The symptoms are not unlike "pinging" and are more likely to occur when the engine is loaded, ie,

*Continued from page 37*

**HI-FI REVIEW**

correction is pretty good but it is not the best we have seen so far.

These newer generation machines also have generally improved tracking performance over earlier models. As yet there is no objective test for this so we have to judge it by variously bumping and jolting the player to make it mistrack. Another good test is to stand a compact disc record case on edge on the top of the player cabinet and let it fall flat.

Most players are upset by this simple test and will audibly mistrack. On the whole, the CD-1000 seems reasonably proof agaisnt vibration and is on a par with most other players.

Overall, the CD-1000 performs very well. It is perhaps a little slow to respond to user commands but that is only a small quibble.

Retail price of the Realistic CD-1000 is $599.95.

Realistic audio products are available Australia-wide through Tandy stores. (L.D.S.)

when accelerating uphill.

Some cars are far more prone to cross-fire than others because of the layout of the ignition HT leads. Probably the worst car in this respect was the VW beetle but it only had four cylinders!

Your system of multiple firing pulses to the SCR gate may well extend the spark duration and thereby mitigate the problems of cylinder misfire in late model cars with lean mixtures. However it can do nothing to solve the problem of cross-fire which is due to the very fast rise-time of the coil voltage and the distributed capacitance of the ignition HT wiring.

And after our previous comments concerning complexity, there is no way we could endorse your circuit which uses three 555 ICs (which has a maximum operating temperature of 70°C, by the way, for the normal version), nine transistors, ten diodes, 22 capacitors and 36 resistors.

Such a design, no matter how ingenious, must be regarded as a dangerous proposition in a motor car. Pull it out.

## Cassette tape beeps explained

In the October 1984 issue of *EA*, T.W. of Broken Hill enquired about a low frequency pulse found on pre-recorded cassettes. This pulse is known as a "marking pulse". When this pulse is played back on a high speed copier, it resembles a beep, and this beep triggers a mechanism that cuts the tape prior to inserting it into the shell.

The pulse can be removed before sale, but it is impractical to do so. If the tone is a serious enough problem, it can be removed at home by either erasing or splicing out the pulse. (R.A., Frankston, Vic).

● Thanks for your helpful information.

## Digital recording from Compact Disc

I have just read your excellent magazine, "The Sound Revolution". Your article on how to record digital sound was very interesting. I am no electronics expert, but I have an idea on which I would be very pleased if you would comment and perhaps give some advice.

I have a Yamaha CD-X1 compact disc player. I want to record digital sound from this on to my Aiwa F660 cassette deck. What I want to know is, is there a way to tap into the CD player and record the digital information from the laser, before it reaches the analog stage, on to a cassette store and then play it back through the CD player using its digital-to-analog converter by once again tapping into the circuitry.

I would be pleased if you could advise me if this is possible, or if this has already been done. Better still, has anyone brought out a kit, or circuit to achieve this aim? It seems to me that this would be a lot better than using a VCR and PCM. (G.D., Hamersley, WA).

● There is one big problem with your idea for recording the digital information from a compact disc. The data rate, as it is read off the compact disc by the laser, is 4.3218Mb/s. In other words, it is 4.3MHz, which is way beyond what can be recorded onto an audio cassette deck. Sorry.

## Trouble-shooting the Motorcycle Intercom

I recently purchased the Motorcycle Intercom described in February 1984 from a reputable electronics distributor and constructed it.

Unfortunately, this circuit did not work. Rather, at a very low volume, feedback resulted. After extensively checking the circuit for faults — and finding none — I concluded there could be something wrong with the circuit itself and I was hoping you could help me in this regard by replying with any faults you may have found. (P.R., Manly West, Qld).

● We are not aware of any design faults with the Motorcycle Intercom project. The following is a brief troubleshooting guide which may help you locate the problem.

We are assuming that the regulator output voltage (9V) is correct and that the problem you refer to is not induced by ignition noise. Firstly, disconnect both plugs. Check the voltage at the junction of the two 100kΩ resistors (shown just to the right of IC1b on the circuit diagram). This should be very close to half supply voltage. (4.5V)

This voltage should also appear at pins 2 and 5 of IC1.A similar voltage should appear at pin 3 of IC1. If the voltage at pin 3 is not close to half supply, there is a fault around IC1a. This could be either

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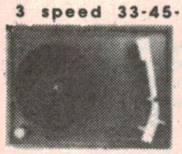
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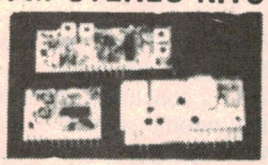
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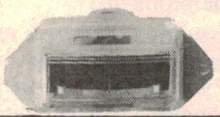
Sets of 3 modules includes FM tuner decoder and if detector. Circuit diagram supplied.

**ONLY $22** PP $1.40

Send stamped envelope for copy of Electronics Australia magazine review of the units.

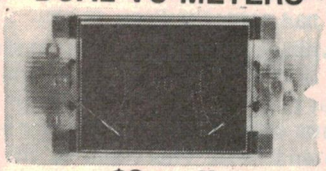
## SPECIAL
## BALANCE METERS
*CENTRE ZERO*

**$2** PP $1



## 6P VALVE SOCKETS
9 pin 25c — 7 pin 25c — octal 25c.

## SPECIAL
## DUAL VU METERS



**$3** PP $1

## ICs

| | | | |
|---|---|---|---|
| 74LS76N | 50c | SAA5050 | $2.50 |
| 74SL74N | 50c | 747S08N | 50c |
| 74LS00N | 50c | 74L392N | 50c |
| 14011UB | 50c | 74LS174N | 50c |
| S041P | $1.00 | SN29848N | 50c |
| 2612N | 50c | MC14011UB | 50c |
| 74LS157N | 50c | NES560N | 50c |
| 53114N | 50c | 74LS90N | $1.50 |
| MM53114N | 50c | 74LS93N | $1.50 |
| HEF4024BP | $1.50 | SC87024P | $2.50 |
| MM57186N | $2.50 | S7646211B | $1.00 |
| HEF4024BP | | 74LS90N | 50c |
| 74LS76N | 50c | HEF4011BP | 50c |
| MC1306P | 50c | 74LS10N | 50c |
| 2112B | 50c | SN29862N | 50c |
| 2112N | 50c | HEF4019BP | 75c |
| SC87024P | $2.50 | NE566N | 50c |



## SPEAKER
2-way crossover networks
*30 WATTS RMS* **$2**

**CRYSTALS** for colour TV $1 each

**SPEAKER TRANSFORMERS** for valve radios
7000 to 15 ohm **$4.50**
7000 to 3.5 **$3.50**

**SPARK GAPS** 10 for $1

**455KC IF Trans** for valve radios $1 each
OS coils 75c each

**THERMISTERS** 4 for $1

**DIODES BY 406** 10 for $1

**CAR RADIO** Suppressors 5 for $1

**SPECIAL**
Chrome ¼ shaft push-on knobs. **10 for $1.**
Usual price 60c to 80c each.

**IC SOCKETS**

| | |
|---|---|
| 24 pin | 35c |
| 28 pin | 40c |
| 18 pin | 25c |

**Slide pot knobs** 10 for $1

TRANSISTORS AD161-162 **$1** pair
100 mixed Capacitors, fresh stock, all handy values **$2** AD149 **$2** pair
100 mixed resistors, handy values **$2**

## STICK RECTIFIERS
TV 20-SC $1 each

**SUPER SPECIAL JVC CD FULL 4 CHANNEL MODEL 4VR 1006 AM/FM TUNER AMPLIFIER 40 WATTS RMS**

Normal price over $600
our price only $195 each
instruction manual included.
PP NSW $4.00
Interstate $12.00
TAS. $21 WA/NT $21



## POTS ROTARY

| | | | |
|---|---|---|---|
| ½ Meg | 50c | 10K Switch | 50c |
| 1 Meg | 50c | 250K | 30c |
| 100K | 30c | 50K | 30c |
| 100K Switch | 50c | 20K | 30c |
| 50K Double Pole Switch | 50c | 10K Min Pots | 25c |
| 7.500 | 30c | 50/ohm | 50c |

Extra Pots ¼mg LIN 50c
½ or 1 Meg Switch 50c
½ 1 meg dual Concentric tapped at 100K $1
2 meg ganged double pole switch $1
1.5 meg dual ganged 50c 2 meg ganged log $1
1 meg dual ganged $1 ½ meg dual ganged LIN 75c
25K 50K dual ganged Concentric double switch $1
100K dual ganged linear pots 75c

| | | | |
|---|---|---|---|
| 200K single line | 30c | 10K sub min log pots | 50c |
| 20K wire wound | 75c | 250K ganged pots | 75c |
| dual log 10K | 75c | 25K in ganged pots | 75c |

## PYE TV TUNERS
*FOR B/W TV SETS* **$7**
PP NSW $1.80; VIC $3.60; QLD $3.60; TAS $4; WA $5.

## MICRO SWITCHES
5A 250V 50 cents

## VALVES

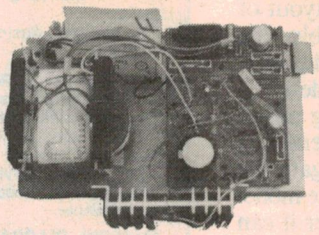
| | | | | | |
|---|---|---|---|---|---|
| EF86 | $4.00 | 5AS4 | $4.00 | 6AV6 | $3.00 |
| 12AX7 | $4.00 | 6V6 | $10.00 | 108 | $4.00 |
| 12AU6 | $4.00 | 6AL3 | $4.00 | VT121-955 | $5.00 |
| 12AX7 | $4.00 | 6GV8 | $4.00 | ECH33 | $7.00 |
| 6BM8 | $3.00 | 6SA7 | $5.00 | 6C8VT163G | 3.00 |
| 6BL8 | $3.00 | 6Y9 | $4.00 | VT86 | $5.00 |
| 6BD5 | $4.00 | 6BE6 | $5.00 | 6H6 | $4.00 |
| 6K8 | $10.00 | 6BH5 | $5.00 | 6V4 | $5.00 |
| 6K7 | $7.00 | IT4 | $2.00 | 6U7 | $7.00 |

## SLIDE POTS

| | | | |
|---|---|---|---|
| ½ meg dual | $1 | 1K dual | $1 |
| 1 meg dual | $1 | 50K single | 50c |
| 2 meg dual | $1 | 250K single | 50c |
| 25K dual | $1 | 10K single | 50c |
| 250K dual | $1 | 2 meg single | 50c |

## TOUCH MICRO SWITCHES
As used in front control panels in colour TV sets.
**4 FOR $1**

## KRIESLER POWER SUPPLIES



*For Late Model Colour TV Sets 2-51A*

**$50**

PP: NSW $3; VIC $5; QLD $5; WA $6; TAS $6; NT $7.

## CELLULAR HORN TWEETER HT.3




p.p. $1.40

**Mounting Specification**
12.5cm x 7.1cm
Frequency Range:
2000 — 20,000Hz
Impedance: 8 Ohms
Sensitivity: 105 dB
Maximum Power:
30 Watts

**Capacitors ELECTROS**

| | |
|---|---|
| 2500 16V | 4 for $1 |
| 220 16V | 4 for $1 |
| 1000 UF 50V | each $1 |
| 1000 UF 63V | each $1 |
| 22 UF 160V | 3 for $1 |
| 1000 UF 16V | each 50c |
| 63 UF 25V | 5 for $1 |
| 470 UF 63V | each 50c |
| 47 UF 160V | 3 for $1 |
| 470 UF 25V | 4 for $1 |
| 40 UF 25V | 5 for $1 |
| 470 UF 40V | 3 for $1 |
| 47 UF 10V | 10 for $1 |
| 100 UF 25V | 5 for $1 |
| 25 UF 25V | 10 for $1 |
| 470 UF 16V | 5 for $1 |
| 220 UF 50V | each 50c |
| 47 UF 200V | each 50c |
| 1000 UF 10V | 4 for $1 |
| 2.2 UF 200V | 4 for $1 |
| 22 UF 16V | 10 for $1 |
| 330 UF 63V | each 50c |
| 1MFD 50V | 10 for $1 |
| 33 UF 10V | 10 for $1 |
| 33 UF 10V | 10 for $1 |
| 1MFD 50V | 10 for $1 |
| 33 UF 10V | 10 for $1 |
| 0.0039 1500V | each 50c |
| 6N8 1500V | each 50c |
| 220 UF 35V | 4 for $1 |
| 1000 UF 25V | each 50c |
| 680 UF 50V | each 50c |
| 22 UF | 10 for $1 |
| 100 UF 6.3V | 10 for $1 |
| 330 UF 25V | 3 for $1 |
| 2000mfd 25V chassis mount | $1 |
| 50mfd 400V chassis mount | $1 |
| Dual 75mfd 65V 20mfd 450V chassis mount | $1 |

## Colour convergence coils
Delta 11270 ..... $5

## Hor Drive Transformer for Colour TV —
3021, 39/6 ..... $3

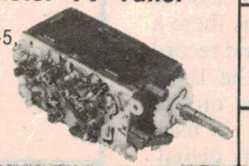
## Power Transformers ..... $15
240V 100mil 285CT 285 6.3/5V pp:
pp: NSW $3; Qld, Vic. $4.80; Other States $7.

240V 285 ASIDE 6.3 60ml ..... $10
pp: NSW $3; Qld, Vic. $4.80; Other States $7.

240V 150v 6.3/30mil ..... $6
pp: NSW $2; Qld $4; Vic $4; Other States $6.

## Power Transformers
240V 2 amp 30V 12V ..... $10
Prim 240V sec-240V 60MA ..... $5
pp: NSW $2; Qld, Vic. $4.80; Other States $6.

## Transistor TV Tuner

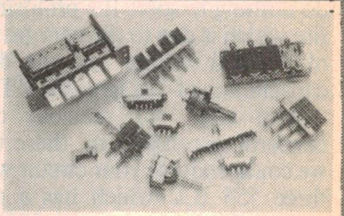


MSP 46300-5, 11 volt

**$10**
p.p. $1.40

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Push Button Panel with Speaker
**$20**
without speaker
**$15**





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PLUS MANY MORE FEATURES

MODEL AR 650

RRP $369 PP $199 ONLY

| | |
|---|---|
| NSW | $3.00 |
| VIC | $4.80 |
| Qld | $4.80 |
| TAS | $15.00 |
| WA | $15.00 |
| NT | $18.00 |

## SPEAKER SPECIALS
*PP: NSW $2.80; INTERSTATE $4.20; WA/TAS/NT $7*

| | | |
|---|---|---|
| Magnavox | 10 inch | $8.00 |
| MSP | 8 inch dual cone | $5.00 |
| MSP | 9 x 7 | $6.00 |
| | 5 x 7in 8/or 15 ohm | $4.50 |
| | 8 x 4 8/or 15 ohm | $4.50 |
| | 6 x 4 8/or 15 ohm | $4.50 |
| | 6 x 4 8/or 15 ohm | $3.50 |
| | 6 inch dual cone | $6.00 |

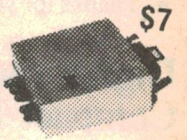


Mini woofer mid range

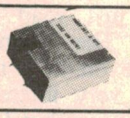
| | |
|---|---|
| 5 inch dual cone 27/ohm | $5.00 |
| 4 inch 27/ohm | $4.00 |
| 4 inch 4/ohm | $4.00 |
| 5 inch 4/ohm | $4.00 |
| 5 x 4/ohm | $4.00 |
| Tesla Mini woofer 4 or 8ohm 4 inch 10 watts | $5.00 each |
| 4 inch 10 watts RMS 4/or 8/ohms | $10 pair. |

## Infra Red Audio Transmitter
for colour TV
3102-108-50301

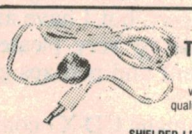
**$7**



**$6**



## Video Det & AFT
3102-108-58741



## SPECIAL! TRANSISTOR EAR PIECES
with plugs & leads — top quality in sealed plastic packets
**4 for $1**

SHIELDED LEADS

| | |
|---|---|
| 3.5 to 3.5MM 7ft | $1 |
| 6.5 to 3.5MM 7ft | $1 |
| 6.5 Single ended | 50c |

## Electric gramophone motors
240 volt 3-speed **$5**



**Minituning capacitors** 50c
Sub mini **75c**

the input circuitry, the supply to the IC or the IC itself.

Similarly, check the voltage at pin 4 of IC1. This should also be close to half supply. If not, one of the above mentioned faults must exist.

Assuming that IC1 checks OK, measure some voltages around the power amplifier. These should be in the vicinity of 8.4V at the collector of Q1, 4.7V at the base of Q3 and 4.5V at its emitter. The voltage at the base of Q4 should be about 3.7V. If all of these voltages appear to be correct, repeat the whole exercise for the other channel and then repeat with the plugs replaced.

If at any stage you measure a voltage which departs significantly from the above values, be sure to correct it before continuing the test.

## Advice on buying a personal computer

I would like to make a few enquiries concerning home computers as I am considering obtaining one for myself. I have read your article in the June 1984 issue and other articles published on home computers. However, I feel I could use some expert advice as to the type of computer that would best suit my needs.

The computer I would like would need to be able to provide control of home appliances, personal programs, financial affairs and entertainment. My enquiries made at various stores and the types of computers were Commodore 64, Vic 20, Atari, Tandy TRS 80 and Dick Smith Cat. The various salesmen recommended their own computer and I found some parts unavailable. Several also did not have circuit diagrams available for study.

So as you can see I have a dilemma as to which computer is really best suited to my needs and the availability of parts. I would appreciate any advice you may be able to offer me. (G.K., St Agnes, SA).

● You are certainly not alone in your dilemma. All the machines you mention could probably be adapted to suit your needs but inevitably, you won't be fully aware of the possibilities until you have had some months of experience with a computer.

With that in mind, perhaps the best approach is to buy a very cheap machine such as the Dick Smith VZ200 or Tandy Model 100. This way you will only invest a small amount of money in a learning experience.

After buying and using a cheap machine for several months you may find that it has all the facilities you need.

## No output from stereo simulator

I have built the stereo simulator, April 1983 but it is not working as planned. The input is from a Sanyo TV earphone mono socket and the outputs are connected to aux input of an amplifier. When on the only sound coming from the amp is a highly static version of the local radio station.

The voltages of the op amps are 12V at pin 7 and 6V at pin 6. The sound of the radio station is only heard when the input of the simulator is connected to the TV. (C.W., Warilla, NSW).

● The fact that the DC voltages in the circuit are correct indicates that both op amps are working. You probably have an open circuit in either the input or the output of the circuit. Check the board very carefully for hairline cracks or poor solder joints.

## Notes & Errata

**ELECTRONIC MULTIMETER** (October 1984, 7/M/66): As presented, the circuit will not work properly when measuring AC current. The input coupling capacitor is far too small for this mode. The simplest solution is to short out S3a and omit the 0.1μF capacitor across it. This means that an external DC blocking capacitor will be needed if measuring AC voltages which are superimposed on DC.


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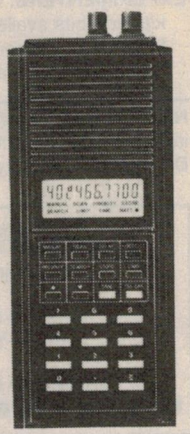
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- AM For Air Band
- 20 CH Memory
- Clock Priority CH

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- AUDIO OUTPUT: 0.5W

COMES COMPLETE WITH NICAD BATTERY, CHARGER AND ANTENNA ONLY **$399**



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**EXPERIMENTERS:** Wide range of electronic kits and bits available. Contact: Bridge Road Electronic Discounts, 508 Bridge Road, Richmond Victoria 3121.

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*Continued on page 128*

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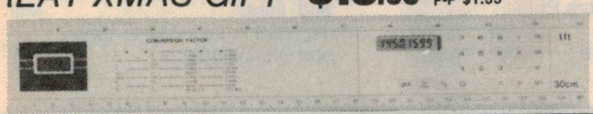


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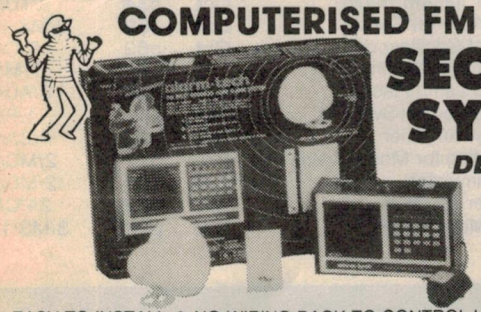
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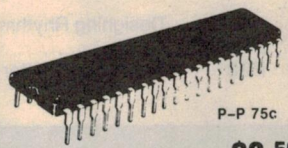
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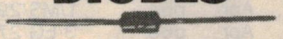
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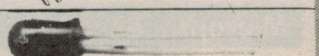
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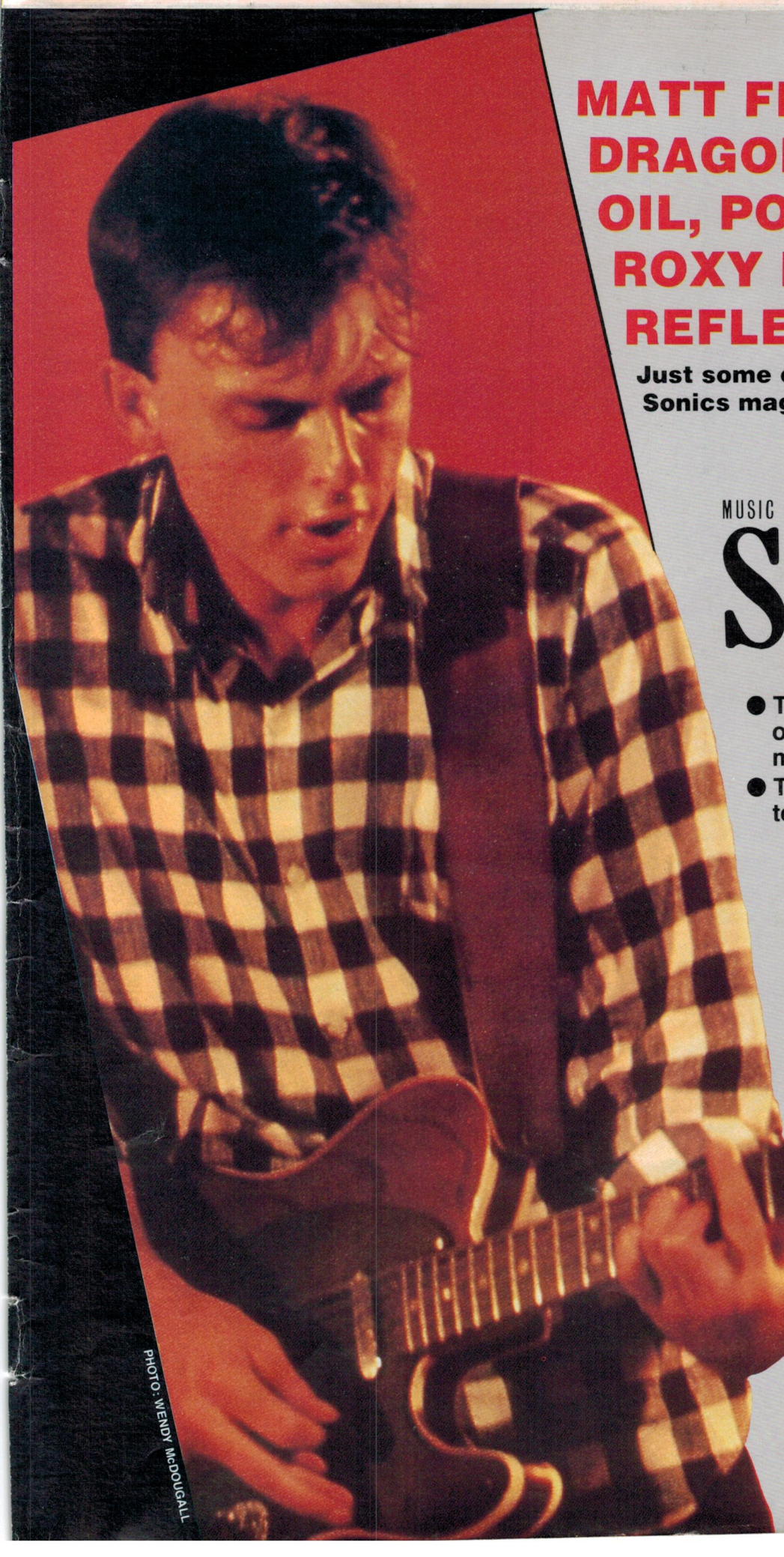


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- CPS (Computomatic Program Search)
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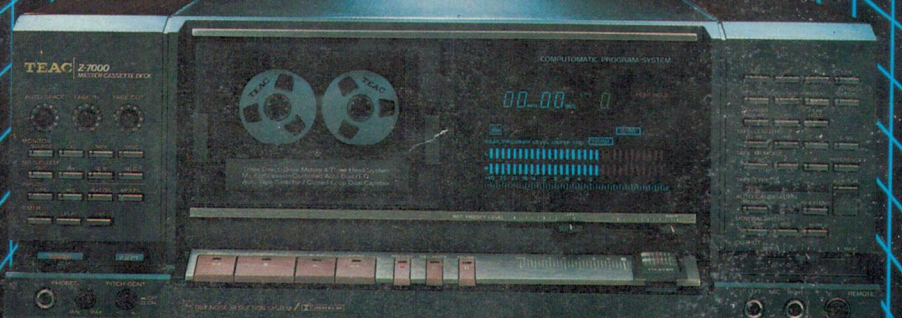
- 3 direct-drive DC motors
- Direct-coupled playback EQ amplifier
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Manual recording bias, level and EQ calibration system




Z-6000

- Dual-capstan closed-loop transport system
- Real time tape counter
- Automatic tape select
- 30-segment FL peak level meters
- Memory repeat/play/stop
- CPS (Computomatic Program Search)

- 3 direct-drive DC motors
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Automatic recording bias, level and EQ calibration system
- Tape calibration memory
- Block Repeat




Z-7000

- Dual-capstan closed-loop transport system
- Real-time tape counter
- Automatic tape select
- Search To Cue, Search To Zero, Search To Record
- Spot Erase System
- CPS (Computomatic Program Search)

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